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Financial Cycles: Determinants and Policy Implications

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À *mes parents, à mon petit frère,*

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Résumé

Cycles financiers : Déterminants et implications de politique économique

Cette thèse analyse les déterminants et les conséquences des cycles financiers, afin d'en fournir des recommandations de politique économique. Ce terme relativement nouveau invoque aussi bien le comportement pro-cyclique des agents financiers que le cycle de différentes variables, tels que le crédit, et les marchés boursiers et immobiliers. Cette définition permet de dissocier le cycle financier national de l'international.

Dans un premier temps, cette thèse propose de nouveaux déterminants aux cycles financiers nationaux. Je mets en avant le rôle primordial de la structure de la dette en termes de maturité. A travers une analyse flux-stock, je démontre que la dynamique de la dette suit généralement une tendance sous-optimale, tantôt trop axée sur les dettes de court-terme, tantôt trop tournée vers le long-terme. Cette thèse propose aussi un deuxième nouveau déterminant de ces cycles financiers, à savoir l'évolution des inégalités. J'en tire trois prédictions théoriques, qui se vérifient dans mon analyse économétrique: i) la hausse des inégalités conduit à une augmentation du crédit aux ménages au niveau agrégé; ii) l'essentiel de ce lien de causalité est tiré par le rôle clé des classes moyennes; iii) ce lien de causalité positif existe si et seulement si le pays est suffisamment développé.

Dans un deuxième temps, j'analyse les conséquences du cycle financier global, conduit principalement par la politique monétaire américaine. Je démontre que l'exposition domestique aux forces étrangères, en particulier via la présence de banques globales, réduit l'autonomie de la politique monétaire, mais que ce cycle ne change pas la nature du triangle d'incompatibilité de Mundell.

Contents

List of Figures

List of Tables

General Introduction

Both emerging and developing world undergo a period of intensive changes in the ways they design their policies. The volatility of capital flows is among main challenges: capital flows increased more than eightfold between years 2000 and 2007, from $82 billion to $660 billion. As a response to the Great Recession, the capital flows fell noticeably to $115 billion in 2008. However, following massive unconventional monetary policies implemented by the Federal Reserve and the ECB, the capital flows recovered their pre-crisis levels in 2009. Dilma Roussef described these policies from advanced economies as a *monetary tsunami* and the Brazilian Finance Minister Guido Mantega spoke of *currency war*. Large capital inflows could generate appreciation pressures, trigger credit booms and fuel speculative asset bubbles, as suggested by Mendoza and Terrones (2008), Blanchard et al. (2015), among others. Conversely, the gradual withdrawal of the quantitative easing program announced by Ben Bernanke in the 2013 summer generally does not simplify domestic monetary policy for policymakers. This *taper tantrum* deepens financial vulnerabilities, leading to strong downward pressures on emerging currencies and increasing the likelihood and the strength of further domestic financial crises. Therefore, the current uncertainty about a new *taper tantrum* and the Yellen's strategy for Fed policy point out the urgent need of policymakers in emerging markets for efficient tools to isolate their domestic financial markets from US monetary policy. The spillover effects from the Fed are large, because it drives global liquidity and because of the high level of comovement in asset price, credit, spread and risk aversion around the world. This worldwide trend is called the *global financial cycle* by Rey (2015).

The notion of financial cycles is in line with the conventional logic of business cycles and involves the boom-bust cycle in credit, equity and housing markets as well as the procyclical behavior of agents. This brings up three questions:

1. How do financial cycles differ across countries? It is necessary to distinguish between national and international financial cycles. They are intertwined, because capital markets are becoming increasingly integrated. But there is also a possibility that these cycles could be different in terms of frequency and amplitude.

2. What drives these financial cycles? Monetary, fiscal and financial policies clearly affect them, but the role of specific currency or the specific risk-taking of agents should not be overlooked.

3. What are the consequences and the policy implications of these financial cycles? They exhibit new transmission channels, which in turn significantly modify the art of policymaking.

National Financial Cycles. Claudio Borio and other BIS economists have analyzed and assessed national financial cycles of world's major economies. This term is fairly new and without consensual definition. Borio (2014) offers the following definition: *it denotes self-reinforcing interactions between perceptions of value and risk, attitudes towards risk and financing constraints, which translate into booms followed by busts. These interactions can amplify economic fluctuations and possibly lead to serious financial distress and economic dislocations.* This general definition allows to distinguish the national financial cycles from the international ones exclusively through the level of integration to the international financial system. This notion also relies on recent macroeconomic literature related to financial amplification mechanism à la Fisher (1933) and to procyclical behavior of agents in the spirit of Minsky (1986).

Drehmann et al. (2012) and Borio (2014) shed light on different stylized facts: (i) the national financial cycle has a much lower frequency than the traditional business cycle, with an average length of 16 years; (ii) the peaks in the national financial cycle are closely associated with systemic banking crises; (iii) these measures of the national financial cycles are good early-warning indicators of financial crises and (iv) its frequency and amplitude depends on the monetary and financial policies.

The measure of national financial cycles is widely discussed. It has important implications, not only for academic research, but also for policymakers regarding global capital flows and the prevention of financial crises. A large body of literature indicates that the credit cycle is the best measure to predict the peak of these financial cycles, i.e. the best early-warning indicator of financial crises (Jordà et al., 2011; Schularick and Taylor, 2012; Gourinchas and Obstfeld, 2012;

Mendoza and Terrones, 2012; Aikman et al., 2015). In addition, there is a bunch of recent academic papers supporting that the most parsimonious description of the financial cycle is in terms of credit and asset prices. Claessens et al. (2010) and Claessens et al. (2012) compare credit, house prices and equity prices cycles whereas Drehmann et al. (2012) use the joint component of credit and house prices, because they *"are more suitable for medium-term cycle"*. They point out a strong synchronization between credit and house prices within countries, especially for advanced economies. By using their very long-turn series since 1870 for 17 advanced economies, Jordà et al. (2013) and Jordà et al. (2015) demonstrate the key role of domestic asset price bubbles associated to a large increase of credit, which significantly improves both the output loss and the predictive ability of future financial crises.

For that matter, this literature also draws a line between household leverage (i.e. housing credit and short-term finance) and firm leverage. Increasing levels of credit do not imply instability if productive investment is funded, triggering an increase in the long-run output: this is the conclusion reached for example by Buyukkarabacak and Valev (2010), who find that business credit is a much weaker predictor of financial crises. In the same spirit, Jordà et al. (2014a) and Jordà et al. (2014b) distinguish household versus business credit and mortgage versus no-mortgage loans in their long-run dataset. They describe how the sharp increase of credit-to-GDP ratios in industrialized economies comes mainly from the rapid growth of loans secured on real estate. They demonstrate that a larger share of mortgage loans leads to a deepen recession. The microeconomic analysis of Mian and Sufi (2010a), Mian and Sufi (2010b) and Mian and Sufi (2014a) refine and supplement this approach. Their disaggregated data by counties suggests that home equity-based borrowing fluctuations explain consumption default, house price and other macroeconomic variables.

A lot of papers discuss other determinants of these financial cycles. Jordà et al. (2016) differentiate public and private debt in their long-run database and underline the key role of private debt rather public debt in the build-up of financial imbalances. Because of the international financial cycles, the external environment is obviously important. The literature investigates the currency composition of debt (Bordo et al., 2010); the level and composition of foreign liabilities (Catão and Milesi-Ferretti, 2014) and the domestic versus foreign credit growth (Cesa-Bianchi et al., 2017).

The Global Financial Cycle. Since Rey (2015), the conventional definition of this global financial

cycle is as follows: *the high degree of comovement in risky asset prices, credit growth, leverage, spreads and financial aggregates around the world.* It put emphasis on the key role of the US monetary policy because of the large spillover effects.

Rey (2015) and Passari and Rey (2015) prove the global financial cycle with the following sequence: US monetary policy drives the global risk aversion and uncertainty proxied by the VIX[1], which in turn push international capital flows. And these waves of flows are highly synchronized around the world and trigger financial domestic vulnerabilities in credit and asset markets. In the same spirit, Miranda-Agrippino and Rey (2015) and Rey (2016) draw attention on the global financial cycle and the international transmission channels of US monetary policy through VAR analyses. At least three mechanisms emerged from Rey (2016), namely:

1. The international credit channel operates through occasionally binding collateral constraints and highlights amplification effects à la Lorenzoni (2008). As surveyed by Mendoza (2017), the recent theoretical foundations on *Fisherian deflation* investigate many different directions. Some papers such as Bianchi and Mendoza (2017) or Korinek and Dávila (2018) link collateral constraint and asset prices, whereas Bianchi (2011), Benigno et al. (2016), Schmitt-Grohé and Uribe (2017), among others, use a collateral constraint depending on real exchange rate and highlight the case of Sudden Stops.

2. The risk-taking channel à la Bruno and Shin (2015a) and Bruno and Shin (2015b) puts forward the synchronization and the compression of risk premia around the world.

3. The thrust of the fear of floating channel started by Calvo and Reinhart (2002). It is the potentially disruptive answer of a central bank to a foreign monetary policy. It generates misallocation, especially by mortgage spreads.

Consistently with these transmission channels, the dollar plays a key role around the world. In contrast with the conventional view, the exchange rate influences risk-taking and an appreciation is expansionary. The exchange rate directly affects the financial conditions, especially for the emerging world. Hofmann et al. (2016) highlight that a currency appreciation against the dollar calls for

[1]The VIX is the weighted average of the implied volatility of Standard and Poor's 500 index options and reflects a market estimate of future volatility. A VIX equal to 23 means that investors anticipate a feasible volatility in the next 3 months in the $+/-23\%$ band. It is currently used as a proxy of risk aversion and uncertainty in financial markets.

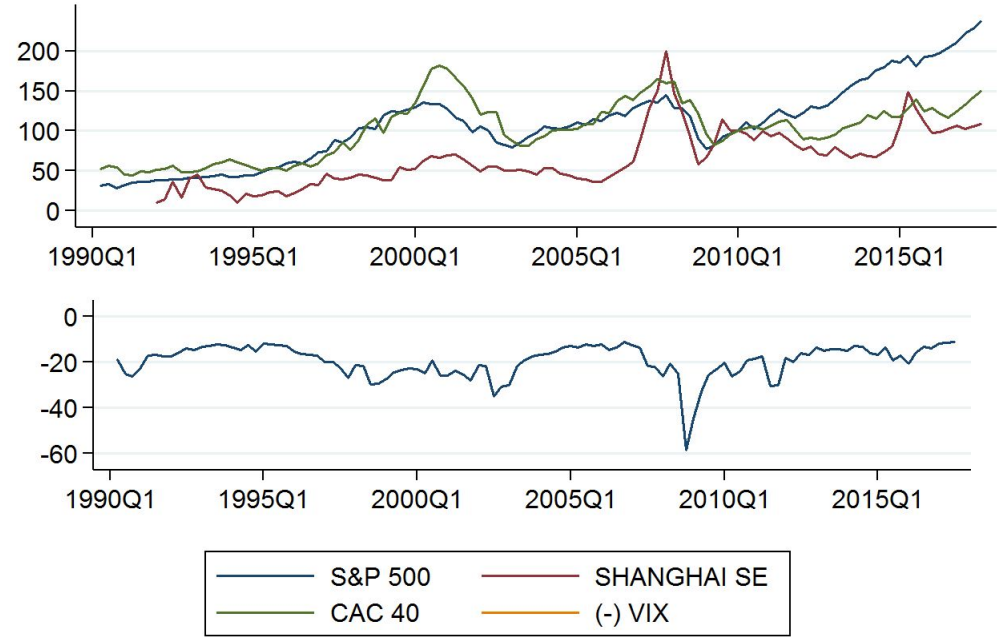
looser financial conditions and compressed risk premium for sovereign debt, while Avdjiev et al. (2017b) explores the dynamics between currency depreciation against the dollar, cross-border flows and domestic investment.

In the same way as for national financial cycles, there exists no single and definitive measure of the global financial cycle. First, Miranda-Agrippino and Rey (2015) and Rey (2015) demonstrate that the VIX is a good proxy for the fluctuations of the global financial cycle, because one global factor explains an important part of the variance of large cross section of returns of risky assets around the world. Second, the TED spread[2] reflects the funding conditions for global banks and may be a good proxy of private credit risk perceptions, close to the VIX. As emphasized by Bruno and Shin (2015b), the TED spread is a significant driver of cross-border bank flows. Similarly, the debate on global financial cycle is also related to the recent empirical literature on global *push* and national *pull* factors (Forbes and Warnock, 2012; Ghosh et al., 2014; Ahmed and Zlate, 2014 and Nier et al., 2014), which expose that the VIX becomes the main driver of capital flows, especially in the expansionary phase of financial cycles.

In addition, this analysis includes *global players*. Goldberg (2013) emphasizes the role of global banks in the transmission channel of the global financial cycle. The global financial cycle are quantified by Avdjiev et al. (2017c) and Cerutti et al. (2017). More precisely, Avdjiev et al. (2017c) recently compared the impact of global financial conditions on cross-border loan flows and international debt securities, whereas Cerutti et al. (2017) take a skeptical view about the real role of US monetary policy. According to the sensitivity analysis of Cerutti et al. (2015), the characteristics of the foreign lenders could be even more relevant than borrower's fundamentals.

This thesis investigates the determinants and consequences of these national and international financial cycles. The former is potentially desynchronized to the latter, led primarily by US monetary policy. Figure 1 sheds light on these potential differences: equity prices in various countries fit the VIX well, but not perfectly. For clarity of exposition, I plot the VIX as negative coefficient. A decrease in the VIX in Figure 1 reflects an increase in global risk aversion and uncertainty, which is closely related to the sharp drop in asset prices around the world during the Great Recession.

[2]It is the difference between the interest rates on interbank loans and on short-term US government debt.



Equity markets index, 2010 Q1 = 100. VIX: quaterly mean.

Figure 1: National and Global Financial Cycles

This allows me to distinguish determinants of national cycles and consequences of the global cycles. First, I exhibit two determinants of these *national* financial cycles, namely inequality and debt maturity structure. I demonstrate how the rising inequality leads to an excessive leverage of low- and middle-income households. I highlight that debt maturity structure as potential other determinant of financial crises for emerging world. Second, I also investigate the consequences of the *global* financial cycle through the traditional trilemma from Mundell (1963).

First Chapter: How does debt maturity structure affect fire sales? The level of debt stock is unambiguously linked to financial crises, according to the previous literature. This stock is both affected by debt inflows and outflows, which themselves depend crucially on the choice between short and long-term debt. The former influences the current and future debt flows through complete debt service in one period, while the latter affects both debt flows and stock over long horizons. But the current empirical and theoretical literature on financial crises is quite silent on this stock-flow relationship of debt, with the notable exception of Drehmann et al. (2017) that focus on the lead-lag relationship of the debt between new borrowing and debt service.

This chapter aims to fill this gap by answering the following three questions: first, how do debt level and maturity structure predict financial crises? Second, because the financial amplification

mechanism *à la* Fisher (1933) is key to understand financial crises, how does debt maturity structure affect fire sales? Third, what is the optimal policy according to this stock-flow relationship?

This financial amplification mechanism appears when collateral constraint tightens. This collateral is based on the market value of assets that determines the borrowing ability of economic agents. When they are not able to repay their debt and/or they want to increase their consumption above this borrowing limit, they could sell their assets. But if many borrowers do the same, it may result in a well-known feedback loop between binding collateral constraints and a drop of asset prices and agent's wealth, as described by Korinek and Mendoza (2014) and Bianchi and Mendoza (2017), among others. These labeled *Fisherian deflation* models use occasionally binding financial constraints with pecuniary externality, which means that decentralized agents do not internalize the effect of their decisions on asset markets. Therefore, there is a wedge between private and social marginal utilities of both asset and debt. As a conventional result, policy intervention via taxes and subsidies could fill the gap. Nevertheless, these recent theoretical foundations of Fisher (1933) remain quite silent on debt maturity structure.

By contrast, I highlight that a debt maturity structure essentially based on short-term debt is a good early-warning indicator of financial crises for the developing world over the period 1970-2012. This indicator has higher predictive power than debt levels and complements the information obtained with proxies of global financial forces around the world. This empirical insight is then rationalized into a *Fisherian deflation* model in which domestic borrowers choose a mix of short and long-term debts. This debt maturity structure complexifies and potentially multiplies the risk of asset-fire sales due to the binding collateral constraint. I find that the mix of these debts chosen by the agent follows a suboptimal path, which triggers financial crises. In addition, this path is not necessarily oriented towards short-term debt, because an excessive reliance on long-term debt generate future binding collateral constraints. It differs from the social planner's optimal path of debt, and more broadly from the social planner allocation including the capital assets.

The social planner can replicate its equilibrium via a set of taxes and subsidies, where all prices and term premium are still market-determined. Following Korinek and Dávila (2018), the social planner implements taxes on debts and subsidies on capital but with two key differences. First, the taxes on short and long-term debts are both macroprudential (i.e. *ex-ante*) and *ex-post* policies, close to the results of Jeanne and Korinek (2016) and Bianchi and Mendoza (2017). Second, and

perhaps more importantly, these taxes on debts are contingent to the debt maturity structure. When the stock of current short-term debt is relatively high compared to the collateral constraint, it yields a positive term premium for the long-term debt, which in turn reduces the need to impose high taxes on debts.

Second Chapter: How does income inequality and its structure affect credit? In this chapter written with Rémi Bazillier and Jérôme Héricourt, we answer to the following question: How does income inequality and its structure affect credit? We first provide an extension of Kumhof et al. (2015)'s framework by distinguishing explicitly between low and middle-class incomes, versus top incomes. Second, we combine supply- and demand-side arguments in the same setting. Third, we can derive from this model two main theoretical predictions, that we will subsequently bring to the data: (i) an increase in inequality leads to an expansion on household credit at the aggregate level; (ii) the bulk of the positive impact of inequality on household credit is driven by middle classes and (iii) the positive causal link from inequality to household credit exists if and only if the country is sufficiently developed.

On the empirical side, literature has also been scarce, and to some extent inconclusive. They use aggregate total credit measures, only top income shares for inequality and no credible explicit treatment for the various endogeneity issues plaguing the relationship between inequality and credit. Endogeneity is a major issue in the proper identification of such a relationship, as both variables are likely to be simultaneously determined by common shocks, and also due to the obvious reverse causality from finance to inequality. We propose a strategy based on variations in ratifications of International Labour Organization (ILO) at the country-level to predict exogenous changes of inequality, and estimate their effect on credit dynamics. Our approach relies on the exogeneity of the waves of ratifications at the international level in the 1970s and the 1990s, while controlling for the other standard macro determinants of credit. The strategy of ILO has changed over time. They have expanded their technical cooperation at the end of the seventies, and have adopted a strategy of active promotion of core labour standards and decent work in the nineties (see the conclusions of the Social Summit of Copenhagen in 1995 and the Declaration on Fundamental Principles and Rights at Work in 1998). Both evolutions led to a substantial increase in countries' ratification which is arguably orthogonal to country-specific developments. As the implementation

of international labour standards has been shown to be inequality-reducing, this exogenous increase in ILO conventions' ratification allows us to identify the causal effect of inequalities on credit.

We find that an exogenous increase in inequality coming from ILO ratification shocks triggers an expansion of credit. However, we show that the size of this effect varies substantially with the structure of income inequality. Starting with the Gini index (scaled between 0 and 1), which can be understood as a synthetic measure of inequality over the whole distribution, a one standard deviation increase is associated with a significant 7 percentage points increase in the household credit to GDP ratio. Effects differ quite substantially when we focus on specific parts of the income distribution. When inequality is measured through the top incomes share, an increase by one standard deviation lifts credit to GDP ratio by 8.5 to 10.3%. Besides, and maybe more importantly, we show that this effect is substantially higher when middle incomes are concerned: when their share in total income increases by one standard deviation (meaning a *decrease* in the inequality of the distribution of income), credit to GDP decreases by 11.5 percentage points, whereas the same increase in low-income share cuts credit to GDP ratio by 6 percentage points. Similar effect can be found with income shares ratios: credit over GDP raises by 10% following a one standard deviation increase in the ratio of top over middle incomes, and by 7.7% following an equivalent increase for the ratio of top over bottom incomes. Therefore, we provide theory-based empirical evidence that inequality is a driver of household credit, not total private credit. Besides, we show that the middle of the income distribution is a key driver of this effect at the aggregate level, more than low incomes.

Third Chapter: Under which conditions there is a Trilemma or a Dilemma? This paper investigates the consequences of the *global* financial cycle through the traditional trilemma from Mundell (1963). It has for a long time been considered as the best international macroeconomist's toolkit. According to this view, countries have to choose two among three objectives, namely monetary policy independence, fixity of exchange rate regime and perfect capital mobility. By contrast, Rey (2015) supports that this trilemma is transformed into a dilemma: countries must choose between monetary policy independence and financial openness, regardless of exchange rate regime. The idea behind this new configuration is that financial flows are transmitted independently of the exchange rate regime. The resilience of domestic economies depends more on the ability of volatile and potentially destabilizing capital flows to get in or out of domestic financial systems rather

than the decision between a peg, a crawling band or a managed floating rate. This controversy has important implications, not only for academic research, but also for policymakers regarding global capital flows and financial vulnerabilities prevention. If trilemma remains valid, researchers should focus on the right configuration between exchange rate regime and financial openness. But if dilemma is true, the effectiveness of various capital flow management such as targeted capital controls and macroprudential regulation toolkit becomes the major challenge.

This paper demonstrates that there is no move from trilemma to dilemma: the increasing financial forces and linkages over time magnify the effects of financial openness but also of exchange rate management. It is in line with an extensive empirical literature (Shambaugh, 2004; Obstfeld et al., 2005, and Aizenman et al., 2008 and Klein and Shambaugh, 2015). The trilemma is worsened but does not disappear. It suggests that flexing the exchange rate still offers additional leeway for independent monetary policy. My unbalanced sample covers 161 various countries characterized by a large variety of domestic monetary conditions from 1970 to 2013 which is sufficient to highlight trends and potential non-linearities. I take into account various national and global determinants of monetary policy independence and capture potential structural breaks.

A second contribution is to clarify the role of the *global* financial cycle in the trilemma. The sensitivity to the *global* financial cycle depends more on the domestic presence of global investors and global banks than on the fluctuations of these financial forces. So the capital flow management policies should focus on these domestic exposures through *global players*. When the country goes to the worst trilemma configuration, i.e. financially open and with pegged exchange rates, the high presence of one of this kind of *global player* doubles the initial impact of financial forces, especially for global banks.

Consequently, the choice of the exchange rate regime is the fundamental macroeconomic policy choice, especially for small open economies. The decision of whether to peg or not many determine monetary policy options or the ability to maintain open capital markets or both. The exercise that I do fundamentally boils down to the effect of capital market on monetary policy under different currency regime. So these results complement the findings of Rey (2015) and Passari and Rey (2015) on the existence of the global financial cycle, but differs in the intensity and the channel via which it affects monetary policy independence.

Policy Implications. These financial cycles have important implications regarding both advanced and emerging economies. Many policies could make the domestic and international financial system more or less resilient. Overall, economists should answer to the three following main questions posed by Christine Lagarde, IMF Managing Director, at the 18th Jacques Polak Annual Research Conference:

1. How can these domestic and global financial cycles be harnessed to build a safer and more inclusive global financial system ?

2. How do policy decisions of advanced economies drive global financial and economic conditions felt by the rest of the world?

3. How precisely do these conditions get transmitted across countries?

This thesis contributes to the collective answer. The reduction of inequality appears as an important policy, especially in advanced economies but also in emerging world with a sufficient level of development. Indeed, these rising inequalities could trigger risky household leverage bubbles. Focusing on emerging world, the policymaker should also implement macroprudential (i.e. *ex-ante*) and *ex-post* policies. Specifically, they should conduct taxes on both short-term and long-term and subsidies on capital in boom and bust times. Because of an excessive reliance on long-term debt, the overborrowing mechanism could broadened over time. *Ex-post* policies are often disregarded and yet they are key: for a given level of debt, a particular debt maturity structure may extend the financial crisis. Finally, the third chapter on the Mundellian trilemma is a call for including exchange rate regime into the capital flow management policies. The choice of specific exchange rate regime still could help to isolate a domestic country against financial pressures. In addition, it calls for a macroprudential supervision centered on these *global players*.

Chapter 1

Fire Sales and Debt Maturity

How does debt maturity structure affect fire sales? By introducing debt maturity in a *Fisherian deflation* model, I demonstrate how it could trigger financial crises. Using a stock-flow analysis, I show that long-term debt could alleviate the risk of current binding collateral constraint, but an excessive reliance on long-term debt could generate future binding collateral constraints over long horizons. It is empirically confirmed by a study based on 121 developing countries over the period 1970-2012. I highlight that debt maturity structure is a good early-warning indicator of financial crises, which provides information that adds up to the level of external debt.

1.1 Introduction

The level of debt stock is unambiguously linked to financial crises, according to Schularick and Taylor (2012), Mendoza and Terrones (2012) and Gourinchas and Obstfeld (2012). This stock is both affected by debt inflows and outflows, which themselves depend crucially on the choice between short and long-term debt. The former influences the current and future debt flows through complete debt service in one period, while the latter affects both debt flows and stock over long horizons. But the current empirical and theoretical literature on financial crises is quite silent on this stock-flow relationship of debt, with the notable exception of Drehmann et al. (2017) that focus on the lead-lag relationship of the debt between new borrowing and debt service.

This paper aims to fill this gap by answering the following three questions: first, how do debt level and maturity structure predict financial crises? Figure 1.4 in Supplementary Material analyze

the relationship between these notions and the frequency of financial crises. At first glance, it suggests that both external debt stock and over the gross national income and debt maturity structure play a role in the likelihood of future financial crisis. Although there is no obvious relationship with the annual mean of debt maturity structure, the heterogeneous cases, particularly in the 1980s, raise policy concerns. Second, because the financial amplification mechanism *à la* Fisher (1933) is key to understand financial crises, how does debt maturity structure affect fire sales? Third, what is the optimal policy according to this stock-flow relationship?

This financial amplification mechanism appears when collateral constraint tightens. This collateral is based on the market value of assets that determines the borrowing ability of economic agents. When they are not able to repay their debt and/or they want to increase their consumption above this borrowing limit, they could sell their assets. Buf if many borrowers do the same, it may result in a well-known feedback loop between binding collateral constraints and a drop of asset prices and agent's wealth, as described by Korinek and Mendoza (2014) and Bianchi and Mendoza (2017), among others. These labeled *Fisherian deflation* models use occasionally binding financial constraints with pecuniary externality, which means that decentralized agents do not internalize the effect of their decisions on asset markets. Therefore, there is a wedge between private and social marginal utilities of both asset and debt. As a conventional result, policy intervention via taxes and subsidies could fill the gap. Nevertheless, these recent theoretical foundations of Fisher (1933) remain quite silent on debt maturity structure.

By contrast, I highlight that a debt maturity structure essentially based on short-term debt is a good early-warning indicator of financial crises for the developing world over the period 1970-2012. This indicator has a higher predictive power than debt levels and complements the information obtained with proxies of global financial forces around the world. This empirical insight is then rationalized into a *Fisherian deflation* model in which domestic borrowers choose a mix of short and long-term debts. This debt maturity structure complexifies and potentially multiplies the risk of asset fire sales due to the binding collateral constraint. I find that the mix of these debts chosen by the agent follows a suboptimal path, which triggers fire sales. In addition, this path is not necessarily oriented towards short-term debt, because an excessive reliance on long-term debt generates future binding collateral constraints. It differs from the social planner's optimal path of debt, and more broadly from the social planner allocation including the capital assets.

The social planner can replicate its equilibrium via a set of taxes and subsidies, where all prices and term premium are still market-determined. Following Korinek and Dávila (2018), the social planner implements taxes on debts and subsidies on capital but with two key differences. First, the taxes on debt are both macroprudential (i.e. *ex-ante*) and *ex-post* policies, close to the results of Jeanne and Korinek (2016) and Bianchi and Mendoza (2017). Second, and perhaps more importantly, these taxes on debts are contingent to the debt maturity structure. When the stock of current short-term debt is relatively high compared to the collateral constraint, it yields a positive term premium for the long-term debt, which in turn reduces the need to impose high taxes on debts.

Mechanism With only a *one-period* debt, the standard result holds. The decentralized agent is prone to overborrowing. He also under-invests in capital assets that makes the collateral constraint more vulnerable to asset fire sales. Given the debt maturity structure, the previous properties are still valid and the rational borrower chooses his path of debt, while the lender distinguishes these short from long-term bonds. Indeed, the concerns about liquidity and solvency risks are not the same. The lender here charges a term premium, since an excessive short-term debt causes liquidity troubles and exacerbates the risk of default with lower debt amortization process. This paper complements the findings of Jeanne and Korinek (2016) and Bianchi and Mendoza (2017), but differs in the intensity and the channel through which it generates fire sales.

Because of the pecuniary externality and their *unanticipated* shock on capital price, the level and the structure[1] of debt of the decentralized agent could bind one or two collateral constraints. On the one hand, if there is too much short-term debt, the current collateral constraint becomes tight. As a consequence, asset fire sales occur and an *unanticipated* term premium appears, thus further reducing debt capacity. On the other hand, the choice of too much long-term debt alleviates the risk of current binding collateral constraint, but generates future binding collateral constraints over long horizons. When the borrower goes to the worst configuration with the two binding collateral constraints, it pays a term premium and suffers from multiple binding collateral constraints over time.

This stock-flow analysis of the debt is key to understand the likelihood of fire sales mecha-

[1] Jeanne and Korinek (2016) argue that debt maturity is irrelevant in their setup if *"a complete set of state-contingent financial contract is available"*. By contrast, I employ here standard financial friction with state-uncontingent debt *à la* Fernández and Martin (2015).

nism. My findings are complementary to Drehmann et al. (2017) that point out the relationship of new borrowing and debt service as a new transmission channel of financial crises. Using empirical methodology close to the one presented in this paper and data of the Bank for International Settlements (BIS) on advanced economies over 1970-2015, they highlight that debt service is a good predictor of financial crises. By contrast, I demonstrate that the debt maturity structure matters for emerging world. As I develop for short and long-term debt into a *Fisherian deflation* model, they balance the benefits of new borrowing and the future troubles generated by the debt service. This emphasis on low- and middle-income countries adds credibility to the main model assumption, that is the borrower is a price-taker in world financial markets.

Related Literature I introduce debt maturity structure into a *Fisherian deflation* model, whereas this literature generally uses one-period debt. As surveyed by Mendoza (2017), the recent theoretical foundations of Fisher (1933) investigate many different directions[2], but the debt maturity structure has been largely unexplored. Bengui (2011) is the first to ask this question and determines the inefficient risk-sharing between lenders and borrowers through the portfolio of short and long-term debt. In his framework, the social benefit of long-term debt exceeds its private benefit, which calls for tax on short-term debt. Similarly, Shen (2016) includes debt maturity in the Bianchi (2011) framework and captures the trade-off between the insurance benefit and borrowing cost of long-term debt through an exogenous interest rate rule. But it is based on only one sort of bond at the same time with exogenous duration. He describes the effect of an exogenous shock on the duration of the debt. By contrast with these two papers, I focus on the stock-flow relationship of debt in which an excessive dependence on short or on long-term debt is possible. This is in line with Zhou (2018). Her small open economy model generates time-varying term premium through risk-averse international creditors, whereas I disentangle liquidity and solvency concerns. Her result is also complementary to mine as she introduces a state-contingent and maturity-dependent capital inflow controls, while I explore the simultaneous use of both *ex-ante* and *ex-post* policies.

[2]Some papers such as Bianchi and Mendoza (2017) or Korinek and Dávila (2018) link collateral constraint and asset prices, whereas Bianchi (2011), Benigno et al. (2016), Schmitt-Grohé and Uribe (2017), among others, use a collateral constraint depending on real exchange rate and notably triggers sudden stop syndrome in emerging countries. This scope of policy intervention is also widely discussed: see Benigno et al. (2013), Jeanne and Korinek (2016), Hernandez and Mendoza (2017) and Bianchi and Mendoza (2017) on ex-ante versus ex-post policies debate; or Korinek and Sandri (2016) on the simultaneous use of capital controls and macroprudential regulation.

This paper also contributes to the empirical literature studying the key determinants of financial crises. Because of different datasets and various methodologies, multiple predictors have been discussed, such as domestic credit growth (Schularick and Taylor, 2012; Mendoza and Terrones, 2012); domestic credit and real currency appreciation (Gourinchas and Obstfeld, 2012); currency composition of debt (Bordo et al., 2010); level and composition of foreign liabilities (Catão and Milesi-Ferretti, 2014); relative size of the non-tradable sector (Kalantzis, 2015); domestic asset price bubbles (Jordà et al., 2015); private versus public debt (Jordà et al., 2016); domestic versus foreign credit growth (Cesa-Bianchi et al., 2017) and finally debt service (Drehmann et al., 2017). The stock-flow relationship of debt is implicit in Catão and Milesi-Ferretti (2014) when they show that net external debt is a better predictor than gross external debt. By analogy, this work is linked to the recent academic papers analyzing the determinants of external debt flows. Bianchi et al. (2012) and Qian and Steiner (2017) draw attention to the relation between external debt maturity and the level of international reserves. Focusing on 40 economies with relatively high financial development, Avdjiev et al. (2017a) consider how the characteristics of external debt could trigger credit cycles. The choice of the debt instrument and the type of lenders appear to be more important than the currency and the maturity of external debt, but they focus on another sample than in this paper and they could suffer from limited data availability. In addition, my analysis includes global financial forces, which are quantified by Avdjiev et al. (2017c) and Cerutti et al. (2017). According to the sensitivity analysis of Cerutti et al. (2015), the characteristics of the foreign lenders could be even more relevant than borrower's fundamentals, which call for a various term premium over time.

In addition, this paper is related to the large literature which deals with the maturity of the sovereign public debt. Arellano and Ramanarayanan (2012), Fernández and Martin (2015) and Debortoli et al. (2017), among others, discuss the role of debt maturity on sovereign debt crises. By contrast with the collateral constraint used in this paper, they focus on another financial friction, namely limited commitment for repayment.[3] Alfaro and Kanczuk (2009) analyze the choice of debt maturity structure through three factors: term premium, sustainability and service smoothing. Following Broner et al. (2013), the sovereign debt literature on this trade-off investigates two main channels. On the one hand, demand-side arguments put emphasis on the "disciplinary" role of

[3]By introducing two financial frictions (i.e. limited commitment for repayment and for fiscal policy) in their framework, Debortoli et al. (2017) demonstrate that optimal maturity structure of debt is nearly flat.

short-term debt to reduce the incentive to dilute their debt (Jeanne, 2009). On the other hand, supply-side arguments stress the role of the potential uncertainty and the loss of information on the default probability over longer horizons, which calls for a positive term premium. Going into more details, various mechanisms inducing more short-term debt coexist. As developed by Aguiar et al. (2016), the government incentives to deleverage depend on the debt maturity structure since the larger the share of short-term debt, the more able to compute the probability of sovereign default. Another mechanism reverts to consumption smoothing benefits from the debt. Niepelt (2014) compares them to the revenue effect from new debt issuance. The trade-off promotes short-term debt, especially during crises. This theoretical prediction is confirmed by Broner et al. (2013) for emerging countries.

Finally, Ozkan et al. (2017) investigates an *housing channel* of monetary policy close to the liquidity concerns. An easing of monetary policy significantly affects house market liquidity, which in turn improves the probability to sell their asset. Auclert (2017) takes a somewhat different approach and disentangle three redistribution channels from monetary policy to consumption. His *interest rate exposure channel* generalizes and extends the mechanism presented here.

The remainder of the paper is structured as follows. Section 2 describes the empirical strategy and highlights how the debt maturity structure is a good predictor of financial crises. Section 3 presents the baseline model and clarifies the debt maturity structure. Section 4 analyzes the optimal social planner intervention. Section 5 concludes.

1.2 Empirical Analysis: the Role of Debt Maturity Structure

The purpose of this paper is to identify how debt level and term structure affect the likelihood of financial crisis at the country-level. This section first provides details on data sources, including details on various types of debt inflows and outflows. Second, I underline how a debt maturity structure too short-term oriented could play the role of a good early-warning indicator of financial crises.

The unbalanced panel database consists of 121 countries from 1970 to 2012 with 30.4 years per country on average.[4] Table 1.5 in Supplementary Material provides a list of the countries,

[4]This mean is for regressions including the 5 years-lag of each variable, following the baseline specification.

while Table 1.6 gives the data sources. The long time coverage is sufficient to catch regularities with various cases of currency and maturity mismatches. The sample covers almost all emerging and developing economies, which contrasts with the current literature largely focused on advanced economies such as Schularick and Taylor (2012) and Cesa-Bianchi et al. (2017). Another motive is that sensitivities of debt maturity structure to international financial markets should depend on the depth of domestic financial markets and the country's credibility.

1.2.1 Data

Financial Crises The definition of precise dates for asset fire sales is quite challenging. Campbell et al. (2011) and Bian et al. (2017) use high-frequency microeconomic data. By contrast, the well-known dataset of Laeven and Valencia (2012) is used to assess systemic banking, currency and sovereign debt crises during the period 1970-2012. I assume that systemic banking crises are closely linked to the fire sales mechanism. Over 2,4 percent (90) of the sample represents a systemic banking crisis. Alternatively, I could use stock market crash as defined by Reinhart and Rogoff (2009).

External Debt: Stock-Flow Relationship I use the *International Debt Statistics* from the World Bank. This data has been recently employed by Qian and Steiner (2017). They provide a wide range of information. First, they distinguish (i) stock and net flows, (ii) debt service and new debt, (iii) principal and interest payments. Second, they are again decomposed into short and long-term. They also offer the average interest and average maturity on new external debt commitments. As the main explanatory variable, I employ their measure of short-term external debt over total stock of external debt. This measure directly assesses debt structure, whereas Gourinchas and Obstfeld (2012) use the ratio of short-term external debt relative to GDP. I also use the stock and debt service, both with the distinction between short and long-term.[5]

Currency versus Maturity Mismatches Given that exchange rate volatility is a potential source of financial distress (Schmitt-Grohé and Uribe, 2017; Bianchi and Mendoza, 2017), this paper

[5]This distinction and all other measures do not provide a better fit as a early-warning indicator of financial crises. Due to the lower time coverage, I do not use the information relative to the potential publicly guaranteed debt and the distinction between public and private debt.

investigates the relative influence of both currency and maturity mismatches on the likelihood of financial crisis.[6] Four potential measures of currency mismatch emerge from the literature, namely (i) the ratio of foreign currency debt over total debt (Bordo et al., 2010), (ii) the ratio of net national debt or debt service over the net exports of a country (Kuruc et al., 2016), (iii) the ratio of foreign currency liabilities to foreign currency assets of the banking sector (Arteta, 2005; Tobal, 2018) and (iv) foreign currency denominated net unhedged liabilities (Rancière et al., 2010). As emphasized by Rancière et al. (2010), the first one completely ignores the asset side of the balance sheet, and the second one, the potential sectoral imbalances. Finally, the third one assumes that all foreign claims in the foreign currency assets are hedged, whereas unhedged debtors represent an *indirect exchange rate risk*.

Due to data dearth, currency mismatch will be assessed through two types of measures. First, I use ratio of total debt stock (service) over total exports of the country provided by the World Bank. Second, I use the aggregate foreign currency exposure (FXAGG), a measure developed in Bénétrix et al. (2015). Their database is available for 95 countries and covers the period 1990 to 2012. They estimate currency composition of foreign assets and liabilities through geographic exposures. The FXAGG index is bounded between -1 and 1 and a decrease of this index raises currency mismatch issues.[7]

The Global Financial Cycle Another key factor of fire sales is constituted by the international financial forces, because international lenders are potentially affected by various shocks. International financial crises or even domestic economic crises could play a role through multiple transmission channels, such as cross-border bank flows and volatile risk premia. Following Rey (2015), I use the VIX as a proxy of this global financial cycle. The VIX is the weighted average of the implied volatility of Standard and Poor's 500 index options and represents a market estimate of future volatility. It reflects risk aversion and uncertainty in financial markets, and began in 1970 with the Bloom (2009) methodology. Furthermore, I employ other global variables used to estimate the global financial cycle, that is the FED rate and oil prices. The FED rate is notably used in the

[6] Bussiere et al. (2006) analyze the pro-cyclical link between currency mismatch and maturity mismatch (proxied here by the debt maturity structure).

[7] As stated by Bénétrix et al. (2015), "*a value of -1 corresponds to a country has zero foreign currency foreign assets and only foreign currency foreign liabilities, whereas +1 corresponds to a country that has only foreign currency foreign assets and only domestic currency foreign liabilities.*"

Fisherian deflation framework of Bianchi et al. (2016).

1.2.2 Sources of Financial Instability: Debt Size & Debt Maturity

The empirical setting used follows the current literature on early-warning indicators of financial crises, notably the seminal paper by Schularick and Taylor (2012) and more recently Cesa-Bianchi et al. (2017). I investigate the predictive ability of debt maturity structure on the likelihood of systemic banking crisis, which shed light on the causal link between the debt maturity structure and fire sales. The dependent variable is a dummy equal to 1 when systemic banking crisis occur. I consider a logit model of systemic banking crisis event with the following specification:

$$logit(p_{it}) = \alpha_i + \sum_{s=1}^{5} \beta_{it-s} Structure_{it-s} + \sum_{s=1}^{5} \delta'_{it-s} X_{it-s} + \epsilon_{it} \quad (1.1)$$

where $Structure_{it}$ is the ratio of short-term external debt stock over the total external debt stock, $logit(p) = ln(p/(1-p))$ is the log of the odds ratio and X_{it} is a vector of control variables. Following formal lag selection procedures (AIC, BIC), I consider 5 lags for all variables, which is consistent with Schularick and Taylor (2012), Drehmann and Juselius (2014) and Cesa-Bianchi et al. (2017). A first test of the debt maturity structure is analyzing the potential predictive ability to the debt structure when successively including the other key variables relative to debt, that is external debt stock and debt service. According to Schularick and Taylor (2012), the level of domestic debt significantly affects the probability of financial crisis in advanced economies. The similar mechanism holds for emerging countries if I follow the analysis of Cesa-Bianchi et al. (2017) in one of their subsamples. By consequence, external debt size could complement or substitute the role of external debt structure.

As a second test, I introduce international financial forces via proxies of the global financial cycle *à la* Rey (2015) to correctly interpret the national and international determinants. Indeed, the debt maturity chosen by agents in a country could simply reflect the global trend in terms of risk premium and interest rates curve.

Table 1.1 reports the baseline logit specification with successive fixed effects. The presence of country fixed effects catches the specific behavior and reputation of some developing countries. The global trend captured by year fixed effects clearly explains the likelihood of financial crisis, in

Table 1.1: External debt level and structure

	Dependent variable: Systemic Banking Crisis. Logit Estimates.								
	Benchmark								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\frac{ST}{ST+LT}$		2.921*			3.653**	4.063**	5.059**	5.144***	6.246**
Sum of lags		(1.571)			(1.680)	(1.952)	(2.090)	(2.175)	(2.336)
$\frac{Debt\ Stock}{GNI}$			0.331*		0.0203		-0.184		-0.404
Sum of lags			(0.183)		(0.241)		(0.287)		(0.314)
$\frac{Debt\ Service}{GNI}$				7.697**	8.873*		9.743*		7.487
Sum of lags				(3.795)	(4.700)		(5.402)		(5.753)
FED rate						0.0608	0.0713		
Sum of lags						(0.0508)	(0.0561)		
VIX						−0.0906**	−0.100***		
Sum of lags						(0.0365)	(0.0374)		
Oil Price						−1.738**	−2.084***		
Sum of lags						(0.750)	(0.804)		
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	No	No	No	Yes	Yes
Obs.	2351	2351	2351	2351	2351	2351	2351	2351	2351
Countries	68	68	68	68	68	68	68	68	68
Pseudolikelihood	-372.5	-290.8	-295.4	-295.1	-283.6	-260.6	-254.5	-226.5	-222.3
R^2		0.029	0.0141	0.0149	0.0532	0.130	0.151	0.244	0.258
AUROC	0.615	0.634	0.550	0.557	0.633	0.750	0.736	0.824	0.817
Standard error	0.0295	0.0278	0.0300	0.0291	0.0280	0.0222	0.0221	0.0164	0.0160

Standard errors in parentheses. Following formal lag selection procedures, I consider 5 lags of all variables. Table 1.7 in Supplementary Material provide complete specification with all lags. *, ** and *** denote respectively significance at the 1, 5 and 10% levels.

line with Reinhart and Rogoff (2009) and Schularick and Taylor (2012). Column (1) presents the benchmark with only country fixed effects to ensure comparability with the main results. Columns (2), (3) and (4) show that both the debt level and the debt maturity structure are strong predictors of financial crises. The result remains quantitatively identical in column (5) when investigating the three debt variables at the same time. The reliance on short-term debt and the debt service play complementary roles in the rise of financial vulnerabilities. Perhaps surprisingly, the predictive power of debt service is higher than that of debt stock, following Drehmann et al. (2017).

As the underlying theoretical channels of financial crises do not imply that this event is only driven by domestic forces, I also use proxies of the global financial cycle as a falsification test in columns (6) to (7). First, the results on debt maturity structure hold and are robust to any global variable and specification used. The effect of short-term debt is even quantitatively higher than first specification. Second, the global financial cycle is a key determinant of future financial crises, close

to Cerutti et al. (2015) and Avdjiev et al. (2017c). According to Rey (2015), the tightening of US monetary policy significantly worsens financial conditions around the world, which in turn generates financial crises.[8] The unpredictable power of the FED rate is likely explained by collinearity because the same mechanism holds with the VIX. An increase of the VIX in the previous years indicates high global risk aversion and high uncertainty, which increases the risk of financial crisis. The negative sign simply means that there is a strong correlation between prior low uncertainty and financial crisis in the spirit of Minsky (1986). The oil price performs a similar function.

When including year fixed effects in columns (8) and (9), all estimates of debt maturity structure remain identical. These findings also support Cesa-Bianchi et al. (2017)'s results.[9] The year fixed effects are indeed highly statistically significant and support the key role of the global financial cycle in the emerging world. Thus, I adopt column (9) as the baseline specification.

Finally, the predictive power of this model is evaluated by the Receiver Operating Characteristic (ROC) curve. Since Schularick and Taylor (2012), this methodology is common in this literature. It generates a statistic AUROC, namely *area under the curve ROC*. This statistic between 0 and 1 provides a simple information to assess the predictive power of the indicator. An AUROC equal to 0.5 means that it is completely uninformative and it is represented graphically by the 45-degree line. Symmetrically, an AUROC equal to 1 means that the early-warning indicator perfectly anticipates future financial crisis. The relevant benchmark is the AUROC equal to 0.615 defined in column (1) with the country fixed effects and no other variables. Table 1.1 and the associated Figure 1.1 report ROC curves and statistics for the specification in columns (2), (3) and (9). They reveal that the debt maturity structure is a key early-warning indicator of financial crises. The comparison with debt stock level goes in this direction. Including the global financial cycle significantly improves the accuracy of the prediction model.[10]

[8] The US monetary policy both affects the frequency and the magnitude of financial crises. Because of long financial cycles, the calibration of Bianchi et al. (2016) exhibits that the regime shift from high global liquidity to low global liquidity indicates more a substantial increase in the magnitude of financial crises rather than their frequency.

[9] Because of their low subsample on emerging countries, the probability of financial crisis increases with the level of foreign credit only for advanced economies.

[10] Due to the key role of the collateral constraint in the fire sales mechanism, the use of similar empirical measure should complement my findings. Unfortunately, the World Bank data provides few data on this precise idea. I use their measure of bank nonperforming loans to total gross loans in a restricted sample of 1336 points with only one-year lag. The associated AUROC is equal to 0.913. This very high predictive power is in line with Drehmann and Juselius (2014) but drops a large share of the baseline sample.

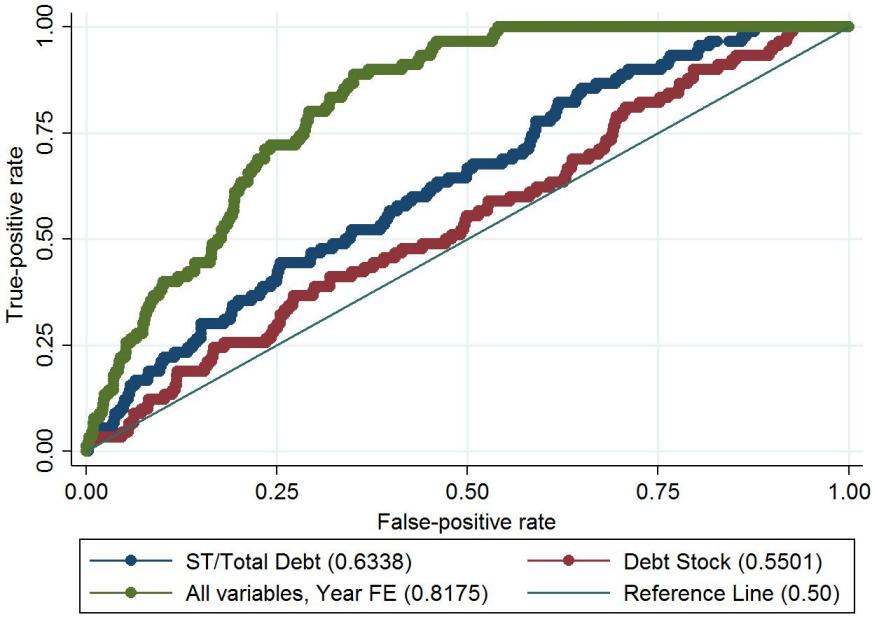


Figure 1.1: Receiver operating characteristic curves (AUROC)

Quantification To document the impact of debt maturity structure in financial crisis, I estimate the predicted probability of the baseline specification with country and year fixed effects.[11] Table 1.2 compares them by differentiating between true-positive signal and false-positive of financial crisis. Out of the total 90 observations of financial crises, the average probability is around 10 percent. This is four times higher than the one of the regular cases, without any financial crises.

In addition, Table 1.2 reports the results of a counterfactual exercise close to Kalantzis (2015). I estimate the probability of the baseline specification without the triggering role of debt maturity structure. Overall, the debt maturity structure significantly improves the probability of financial crisis by 1.5 percentage point on average. It contrasts with the false-positive rate in which the debt maturity structure does not really change the likelihood of financial crisis. The same holds for the difference between the predicted and the counterfactual probabilities expressed in absolute terms.[12] Going into more details, Table 1.2 also highlights specific cases with the highest probability of financial crisis for both true and false alarms. Without the debt maturity structure, the loss of accuracy could be quite substantial. The extreme gap is roughly 25-30 percentage points for Niger in 1983 or Ukraine in 2008.

Furthermore, the high probability of false-positive signals does not necessarily imply a model

[11] Alternatively, Catão and Milesi-Ferretti (2014) maximize the ratio of true-positive to the false-positive in order to define an optimal threshold.

[12] Supplementary Material 1.5 reports the difference for all cases.

failure for two reasons. First, the timing for country-year pairs could be misleading. In other words, the systemic banking crisis appears one year later in Russia, Ukraine and Yemen than pairs listed in Table 1.2. Second, the model could also predict currency and/or sovereign debt crises like Congo, Mongolia, Nigeria and Yemen. These three types of crises are closely intertwined, which in turn hurt model predictions.

Table 1.2: Counterfactual probability of crises without the debt maturity structure

	Nb.	Predicted	Counterfactual	|Difference|
True-Positive Signal	90	0.102	0.087	0.033
False-Positive Signal	2261	0.026	0.027	0.009

Country	Year	Predicted	Counterfactual	Difference
True-Positive Signal				
Guyana	1993	0.622	0.475	0.147
Nicaragua	1990	0.609	0.666	-0.057
Ukraine	2008	0.450	0.201	0.249
Kazakhstan	2008	0.405	0.418	-0.013
Russia	2008	0.395	0.208	0.187
Niger	1983	0.390	0.081	0.309
Paraguay	1995	0.317	0.136	0.181
Mongolia	2008	0.215	0.119	0.096
Turkey	1982	0.179	0.045	0.134
Vietnam	1997	0.169	0.148	0.021
False-Positive Signal				
Swaziland	1998	0.663	0.130	0.533
Yemen	1995	0.537	0.401	0.136
Mongolia	1997	0.416	0.314	0.102
Nigeria	1982	0.397	0.038	0.359
Russia	1997	0.323	0.284	0.039
Macedonia, FYR	1998	0.287	0.340	-0.053
Ukraine	1997	0.277	0.273	0.004
Zambia	1998	0.266	0.366	-0.10
Congo, Rep	1994	0.231	0.165	0.066
Macedonia, FYR	2008	0.227	0.252	-0.025

The sample covers 90 financial crises. The second part of this table only reports the 20 cases with the highest probability of financial crisis.

Currency versus Maturity Mismatches One may argue that the results may be influenced by the risk of currency mismatch. Table 1.3 highlights the results of estimates testing currency and maturity mismatches at the same time, based on two strategies. First, columns (1) to (4) include ratios of net national debt or debt service over the exports of a country as currency mismatch measure. Although 25 percent of the observations are dropped, it supports the previous results. Without any year fixed effects, the relative level of debt service seems to capture external

imbalances. When including year fixed effect, the debt maturity structure still predicts the likelihood of financial crisis. But the comparison of column (2) and (4) does not allow to say whether the currency mismatch index is correctly specified. This uncertainty fits Rancière et al. (2010)'s argument.

Columns (5) to (8) substitute to the previous measure the preferred measure of the aggregate foreign currency exposure from Bénétrix et al. (2015) but it sharply restricts the sample due to lower time coverage. As expected, columns (5) and (6) exhibit a strong negative correlation between the variable *FXAGG* and the likelihood of financial crisis. An increase of *FXAGG* implies greater share of foreign currency foreign assets in foreign assets and/or smaller share of foreign currency foreign liabilities in foreign liabilities, which in turn pushes the risk of currency mismatch. Yet, the correlation holds if and only if there are no year fixed effects. A possible explanation comes from the fact that financial vulnerabilities across countries are highly correlated. When the sample only covers 19 countries between 1990 and 2012, the impact of debt maturity becomes insignificant for almost all specifications. Regarding column (8), it is striking to see that debt maturity is significant when I employ the baseline specification with year fixed effects and all control variables. All in all, Table 1.3 does confirm the importance of maturity mismatch (proxied by the debt maturity structure) in the financial amplification mechanism.

The Spread Channel: Endogeneity issues The debt level and debt maturity structure provide different informational contents. Then, endogeneity is a major issue in the proper identification of the underlying mechanism from debt maturity to financial crises. If term premium is too high because of world or country-specific factors, country (i.e. both public and private agents) is more likely to borrow short-term. In other words, the mechanism works differently depending on whether a country is unwilling or unable to choose more long-term debt.

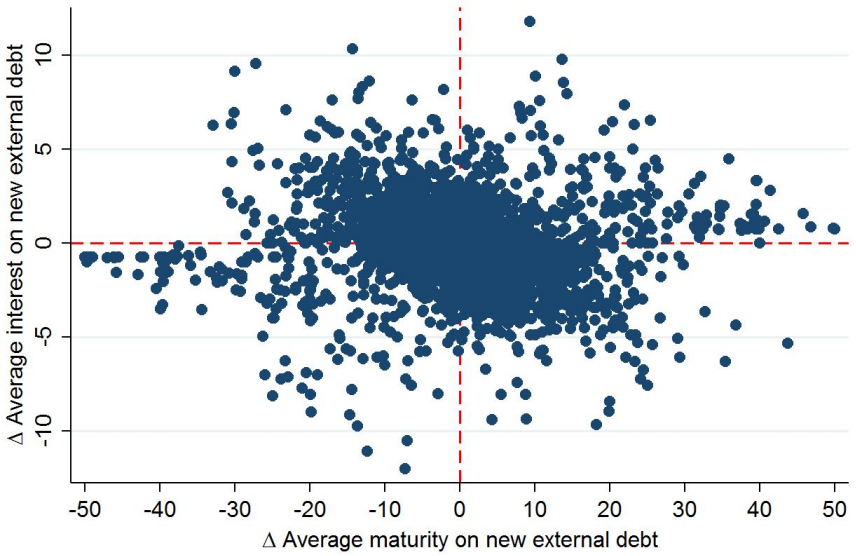
I provide an explicit treatment for this endogeneity issue by controlling for term premium. Data availability for developing world and comparability troubles across countries make the precise term premium estimation impossible. Alternatively, I develop a strategy based on the first difference of average maturity and average interest rate on new external debt at the country-level. The *unanticipated* rise of term premium is caught by cases with a simultaneous rise in interest rates and a decrease in maturity, assuming little composition effects of debt portfolio and no other available

Table 1.3: Currency and maturity mismatches

	Dependent variable: Systemic Banking Crisis. Logit Estimates.							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\frac{ST}{ST+LT}$	3.456*	4.214**	5.498**	5.576**	3.252	6.880	10.93	18.73**
Sum of lags	(1.774)	(1.837)	(2.416)	(2.446)	(3.900)	(4.252)	(6.837)	(9.552)
$\frac{Debt\ Stock}{Exports}$	0.0761		-0.0460					
Sum of lags	(0.0565)		(0.0756)					
$\frac{Debt\ Service}{Exports}$		3.392***		0.810				
Sum of lags		(1.264)		(1.674)				
FXAGG					−3.126*	−8.332***	7.778	3.481
Sum of lags					(1.760)	(2.922)	(5.060)	(7.074)
$\frac{Debt\ Stock}{GNI}$						−5.504**		-2.669
Sum of lags						(2.435)		(3.238)
$\frac{Debt\ Service}{GNI}$						15.84		35.84
Sum of lags						(17.54)		(35.68)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	Yes	Yes	No	No	Yes	Yes
Obs.	1759	1759	1759	1759	319	319	319	319
Countries	62	62	62	62	19	19	19	19
Pseudolikelihood	-233.6	-232.8	-188.6	-190.5	-51.81	-45.67	-26.63	-20.49
R^2	0.0457	0.0487	0.229	0.222	0.0673	0.178	0.521	0.631
AUROC	0.670	0.644	0.805	0.804	0.604	0.649	0.869	0.892
Standard error	0.0290	0.0306	0.0198	0.0197	0.0600	0.0614	0.0295	0.0264

Standard errors in parentheses. Following formal lag selection procedures, I consider 5 lags of all variables.
*, ** and *** denote respectively significance at the 1, 5 and 10% levels.

information. Figure 1.2 illustrates the four possible regions that are labeled with a red dashed line.



Note: Four outliers with an average maturity higher than 100 years (India 2010, Zimbabwe 1982, 1986 and 1987) are dropped for better readibility.

Figure 1.2: Illustration of estimated term premia regions

The lower left and upper right sides of Figure 1.2 clearly fit the basic message of yield curve but do not provide information on the term premium dynamics. By contrast, the upper left side likely captures an increasing term premium, while the opposite holds for the lower right ones. Table 1.4 explores the new information content across subsamples by distinguishing the four regions. When the estimated term premium is on the upper left side, the debt maturity structure drives the dynamics of financial vulnerability. Conversely, no such effect can be observed for all other sides. To sum up, Table 1.4 predicts that debt maturity structure triggers financial crisis through unwanted excessive reliance on short-term debt. It is consistent with the theoretical framework that generates a wedge between decentralized equilibrium and social planner allocation. The former borrows too much, which will then generate a term premium, whereas the latter is looking for optimal path of debt.

Table 1.4: The spread channel - Endogeneity issues

	Upper left		Upper right		Lower right		Lower left	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\frac{ST}{ST+LT}$	7.688**	7.377*	-1.523	1.873	3.016	3.423	3.102	0.352
Sum of lags	(3.670)	(3.784)	(7.038)	(10.30)	(2.574)	(2.684)	(5.971)	(7.535)
$\frac{Debt\ Stock}{GNI}$		0.569		-0.505		0.849		1.412
Sum of lags		(0.582)		(1.501)		(0.638)		(1.142)
Obs.	290	290	67	67	344	344	97	97
Countries	26	26	10	10	30	30	13	13
Pseudolikelihood	-60.48	-56.99	-14	-12.07	-75.61	-72.26	-22.97	-21.34
R^2	0.0608	0.115	0.237	0.342	0.0520	0.0939	0.0895	0.154
AUROC	0.624	0.647	0.747	0.793	0.655	0.693	0.617	0.647
Standard error	0.0527	0.0548	0.0904	0.0671	0.0455	0.0420	0.0925	0.0800

Subsample regressions. Dependent variable: Systemic Banking Crisis. Logit Estimates. Standard errors in parentheses. Following formal lag selection procedures, I consider 5 lags of all variables.
*, ** and *** denote respectively significance at the 1, 5 and 10% levels.

Robustness Tests The Supplementary Material investigates the robustness of my results. First, Table 1.8 replaces logit model by OLS linear probability model for the baseline specification. Even if the latter suffers from various limits, such as the unbonded predicted probabilities, this specification provides similar results with positive and statistically significant effects of short-term external debt as a ratio of all external debt. Quantitatively, it means that a one-unit increase in the five-year average of the ratio of short-term external debt over all external debt (on a [0-1] scale) is associated with an 6 percentage point increase in the probability of financial crisis. It is clearly important, because the sample's frequency of financial crises is around 2.4 percent.

Second, Table 1.9 replicates estimates from Table 1.1 but here all control variables are expressed in first difference. The shift from level-analysis to changes-analysis shed light on the global financial cycle. Both global financial variables (FED rate, VIX and Oil price) have the expected sign with high statistical significance, whereas there is not any impact of debt variables first difference of the likelihood of financial crisis. Finally, Table 1.10 includes additional control variables. The results are globally unaffected by controlling for (i) the level of international reserves, (ii) the use of IMF credit and (iii) the multilateral credit from official agencies owned or governed by more than one country that provide loan financing.

1.3 Baseline Model

The model borrows from *Fisherian deflation* models of financial crises, more precisely from Korinek and Dávila (2018) and Bianchi and Mendoza (2017). I consider a small open economy where agents i belong to one of the two following types, named borrowers B or savers S ($i \in B, S$). Borrowers are potentially more productive than savers at using capital but are subject to collateral constraints that may lead to fire sales. As common in this literature, the market failure generates a difference between the decentralized equilibrium and the social planner, which justifies policy intervention. I introduce debt maturity structure in this framework.

1.3.1 Economic Environment

I resort to a discrete time framework with 3 time periods: $t = 0, 1, 2$. The agent i values consumption of homogenous good c_t^i according to a time separable utility function

$$U^i = \mathbb{E}_0 \sum_{t=0}^{2} \beta^t u^i(c_t^i) \tag{1.2}$$

where the utility function $u^i(.)$ is a standard concave twice-continuously differentiable function that satisfies the Inada condition and β the time-discount factor. At each period, domestic agents receive an endowment of consumption good. I denote by e_t^i the endowment of consumption good received by the agent i in period t. The two agents consume this homogenous good, which serves both as numeraire and is traded as a capital good at price q_t. At date 0, he receives a stock of

capital goods k_0^i and he decides how much to invest or disinvest in the new period at price q_0. At date 1, all the current capital denoted by k_1^i is employed to produce $F_1^i(k_1^i)$ units of consumption goods, where F is a concave, strictly increasing and continuously differentiable production function which satisfies $F^i(t) = 0, \forall t$. Following the literature on fire sales, I assume that borrowers have a better production technology than savers. Again, agents decide how much to invest or disinvest in the new period at price q_1. At date 2, the current capital denoted by k_2^i produces $F_2^i(k_2^i)$ units of consumption goods. Capital is worthless after this date and fully depreciates.

The two agents trade bonds.[13] At date 0, they have access to two bonds b_{01} and b_{02} denominated in terms of homogenous good, where $b < 0$ corresponds to borrowing. They also have an initial level of bonds denoted by b_0^i.[14] The short-term bond b_{01} pays back in period 1 at the interest rate R_{01}, while the long-term bond b_{02} pays back in period 2 at the interest rate R_{02}. At date 1, they have access to a new short-term bond b_{12} with the interest rate R_{12}.

The agent i's budget constraints are given by

$$c_0^i + q_0(k_1^i - k_0^i) + \frac{b_{01}^i}{R_{01}} + \frac{b_{02}^i}{R_{02}} = e_0^i + b_0^i \tag{1.3}$$

$$c_1^i + q_1(k_2^i - k_1^i) + \frac{b_{12}^i}{R_{12}} = e_1^i + b_{01}^i + F_1^i(k_1^i) \tag{1.4}$$

$$c_2^i = e_2^i + b_{02}^i + b_{12}^i + F_2^i(k_2^i) \tag{1.5}$$

Collateral Constraints: Flows and Stock Financial market imperfections that constrain borrowers' choice are commonly depicted as an occasionally binding financial constraint linking bond stock and capital price. It is necessary to include financial frictions in the model because of moral hazard issues between lenders and borrowers. Lenders do not exactly know the household's ability to repay their debt and I assume that lenders can seize up only a fraction Φ of the value of their capital asset holdings in periods 0 and 1.[15] The current literature links one-period debt and current

[13] Various interpretations are feasible. First, savers can be interpreted as international agents, following Bianchi and Mendoza (2017) and Schmitt-Grohé and Uribe (2017). Second, this could be extended to the framework of Korinek and Sandri (2016): their economy is described by domestic borrowers, domestic savers and a large set of international agents, the latter who trade bonds with both domestic agents. In all cases, the economy is price taker in world financial markets.

[14] The endowments and the initial level of bonds are distributed such that in periods 0 and 1 borrowers find it optimal to borrow and savers find it optimal to save.

[15] Jeanne and Korinek (2016) and Korinek and Sandri (2016) include this financial constraint only in period 1. In their approach with one-period bond and with an endowment of capital good in period 1, *"the model solution would be degenerate"* if the constraint in period 0 is binding. By contrast, this model provides (i) a mix of short and long-term debts, (ii) an exogenous level of bonds b_0^i and (iii) a decision on capital accumulation in period 0. These facts allow

collateral, whereas I explicitly include the debt maturity structure and the stock-flows relationship. To avoid defaults, lenders impose to borrowers the following debt stock collateral constraints

$$\frac{b_{01}^B}{R_{01}} + \frac{b_{02}^B}{R_{02}} > -\Phi q_0 k_1^B \tag{1.6}$$

$$\frac{b_{02}^B}{R_{02}} + \frac{b_{12}^B}{R_{12}} > -\Phi q_1 k_2^B \tag{1.7}$$

Because of potential differences in terms of moral hazard problems and the uncertainty on future price in the long run, lenders generally distinguish short from long-term bonds. Indeed, the concerns about liquidity and solvency risks are not the same. At date 0, lenders anticipate that the current value q_0 of the capital good and the current accumulation capital k_1^B of the borrower directly play the role of collateral if the borrower defaults for the short-term debt. Thus, I assume that lenders impose to borrowers the following additional liquidity/debt flows constraint

$$\frac{b_{01}^B}{R_{01}} > -\kappa q_0 k_1^B \tag{1.8}$$

This liquidity constraint yields a positive term premium between the two interest rates R_{01} and R_{02} when constraint (1.8) binds. Lenders charge a term premium because an excessive short-term debt creates liquidity troubles and exacerbates the risk of default with lower debt amortization process. There is no similar liquidity constraint at date 1 because all debt (i.e. short-term bond issued at date 1 and long-term bond issued at date 0) is repaid in date 2. κ and Φ appear as pledgeability parameters that determine the strength of financial amplification, where $(\kappa, \Phi) \in [0,1]^2$ and $\kappa \leq \Phi$. For each combination of feasible $\{\kappa, \Phi\}$, there are four possibilities: (i) no constraint binds; (ii) only the debt flows constraint binds; (iii) only the debt stock constraint binds; (iv) both debt flows and stock constraints bind.

The mix of short and long-term bonds for borrowers plays a role in financial amplification. Figure 1.3 summarizes the feasible states. If one or more collateral constraints in period 0 are binding, the stock collateral constraint in period 1 is not generally slacking but that is not automatic. Indeed, the production function of borrowers F_1^B and the endowment e_1^B may be large enough to avoid another overborrowing case and/or asset fire sales.

for potential asset fire sales in period 0, which in turn will affect the optimal policy regulation.

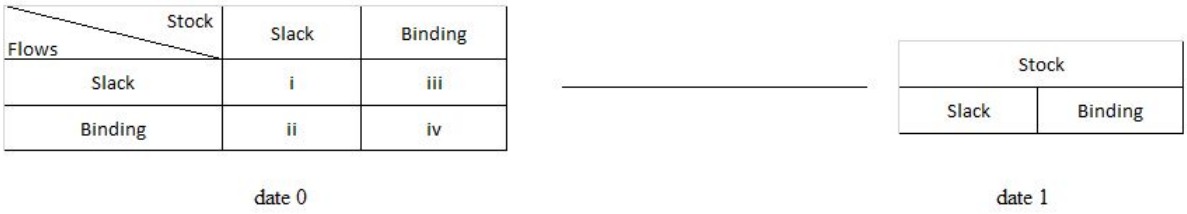


Figure 1.3: Set of possible states

1.3.2 Decentralized Equilibrium

A decentralized equilibrium consists of a set of allocations $(c_0^i, c_1^i, c_2^i, k_1^i, k_2^i, b_{01}^i, b_{02}^i, b_{12}^i)$ and prices $(q_0, q_1, R_{01}, R_{02}, R_{12})$ in which each agent $i \in \{B, S\}$ solves his optimization problem, where all markets clear[16]

$$\sum_i b_{01}^i = \sum_i b_{02}^i = \sum_i b_{12}^i \tag{1.9}$$

Following Korinek and Sandri (2016) and Korinek and Dávila (2018), the decentralized equilibrium is solved via backward induction. The impact of uncertainty on the economy (i.e. on potential binding debt flows and stock collateral constraints) is fully captured by the financial net worth n_0^i in period 0 and by the financial net worth n_1^i and the capital holdings k_1^i in period 1, which are given by

$$n_0^i = e_0^i + b_0^i + k_0^i \tag{1.10}$$

$$n_1^i = e_1^i + b_{01}^i + b_{02}^i + F_1^i(k_1^i) \tag{1.11}$$

Date 2 Equilibrium Each agent consumes homogenous good and settles their bond positions, regardless of whether one previous collateral constraint is binding or not.

Date 1 Equilibrium The problem solved by each agent, who behaves competitively and takes

[16] I assume the uniqueness of the equilibrium. See Schmitt-Grohé and Uribe (2016) on the possibility of multiple equilibria.

prices as given[17], is as follows

$$V^i(n_1^i, k_1^i) \quad = \quad max\ u(c_1^i) + \beta u(c_2^i) \quad \text{subject to} \quad (1.4),\ (1.5) \text{ and } (1.7) \tag{1.12}$$

where λ_1^i, λ_2^i and μ_2^i respectively denote the Lagrange multipliers on the budget constraints (1.4), (1.5) and on the collateral stock constraint (1.7). By construction, μ_2^S is equal to zero.

As common in this literature, the resulting Euler equation for bonds and the optimal capital accumulation decisions are

$$\lambda_1^i \quad = \quad R_{12}\lambda_2^i + \mu_2^i \quad \text{with} \quad \lambda_1^i = U_1^{'i} \quad \text{and} \quad \lambda_2^i = \beta U_2^{'i} \tag{1.13}$$

$$q_1 \quad = \quad \frac{\lambda_2^i F_2^{'i}(k_2^i)}{\lambda_1^i - \Phi\mu_2^i} = \frac{F_2^{'i}(k_2^i)}{R_{12} + \frac{\mu_2^i}{\lambda_2^i}(1-\Phi)} \tag{1.14}$$

Equation (1.13) is the standard Euler equation weighting the marginal benefit of higher consumption today against the marginal cost of lower consumption tomorrow. The additional term μ^i is always equal to 0 for lenders, whereas borrowers may be subject to a binding debt stock collateral constraint. As usual in this literature, this term improves the marginal benefit of higher current consumption of the capital good, that relaxes the collateral constraint. Equation (1.14) characterizes capital price. If the collateral constraint is slack, the price q_1 reduces to a standard Euler equation for assets whereby it equals the marginal product of capital discounted by the marginal rate of substitution. In turn, this provides a relationship between capital price and interest rate. If instead, the collateral constraint is binding, the effect on capital prices is quite ambiguous if I look the middle-hand side of the equation (1.14), close to Korinek and Mendoza (2014). On the one hand, the marginal rate of substitution falls. On the other hand, the denominator of this equation is reduced by the extra-term. It reduces the borrowers' disutility of $U_2^{'B}$ by relaxing the collateral constraint. The right-hand part of equation (1.14) highlights that the result of these two effects is rationalized by the parameter Φ, that is the level of the market incompleteness. At the equilibrium, these optimal conditions (1.13) and (1.14) provide the capital price q_1 and the interest rate R_{12}.

[17] Korinek and Sandri (2016) and Korinek and Dávila (2018) look for the distinction between individual state variables (n^i, k^i) and sector-wide aggregate state variables (n^i, k^i), which can be used to include the pecuniary externality. But this approach might not easily allow for debt maturity structure. This paper introduces the pecuniary externality through another approach, close to Bianchi and Mendoza (2017) and Schmitt-Grohé and Uribe (2017).

Date 0 Equilibrium Following the same way, the agent i takes prices at given, and solves

$$max U^i(c_0^i) + \beta \mathbb{E}_0 V^i(n_1^i, k_1^i) \quad \text{subject to} \quad (1.3), \quad (1.6) \text{ and } \quad (1.8) \tag{1.15}$$

where λ_0^i, μ_1^i and η_1^i denote the Lagrange multipliers on the budget constraint (1.3), on the debt stock collateral constraint (1.6) and on the debt flows collateral constraint (1.8), respectively. Again, by construction, μ_1^S and η_1^S are equal to zero. As in Korinek and Dávila (2018), I denote the term $V_{n1}^i := \frac{\partial V^i}{\partial n_1^i}$ as the private marginal utility of wealth. In the same way, the term V_{k1}^i holds for capital good. Using the envelope conditions $V_{n1}^i = \lambda_1^i$ and $V_{k1}^i = \lambda_1^i q_1$, the maximisation problem yields

$$\lambda_0^i = \beta R_{01} \mathbb{E}_0(\lambda_1^i) + \mu_1^i + \eta_1^i \quad \text{with} \quad \lambda_0^i = U_0'^i \tag{1.16}$$

$$\lambda_0^i = \beta R_{02} \mathbb{E}_0(\lambda_1^i) + \mu_1^i \tag{1.17}$$

$$q_0 = \frac{\beta \mathbb{E}_0 \left[\lambda_1^i (F_1'^i(k_1^i) + q_1) \right]}{\lambda_0^i - \Phi \mu_1^i - \kappa \eta_1^i} \tag{1.18}$$

These conditions are similar to the previous ones, with equations (1.16) and (1.28) for the two types of bonds and equation (1.18) for capital. Two differences appear compared to the period 1 equilibrium. First, the two Euler equations for bonds can be combined to deliver the no-arbitrage condition with a positive term premium if and only if the debt flows collateral constraint is binding.

$$R_{02} = R_{01} + \frac{\eta_1^i}{\beta \mathbb{E}_0(\lambda_1^i)} \tag{1.19}$$

Second, the Euler equation (1.18) at date 0 adds the remaining value q_1 of the capital. It includes the benefit of relaxing not only the debt stock collateral constraint but also the flow ones.

1.4 Normative Analysis

The pecuniary externality generated by the presence of the asset price in collateral constraints may result in asset fire sales, which generally induces a suboptimal decentralized equilibrium. The benevolent social planner internalizes this pecuniary externality in periods 0 and 1. First, he chooses date 0 and date 1 allocations, respecting that all prices are market-determined. Then, the optimal allocation is restored in the decentralized equilibrium by a set of taxes on short and long-term debts

and subsidies on capital.

1.4.1 Social Planner Problem

The social planner problem is close to the date 0 decentralized equilibrium, with two key exceptions. First, the planner directly includes the pecuniary externality through two implementability constraints at dates 0 and 1, namely the Euler equations for capital (1.14) and (1.18). Second, thanks to the previous point, he internalizes the interdependencies between dates 0 and 1. For instance, too many long-term bonds contracted at date 0 could avoid asset fire sales at date 0 but generates them at date 1. As a consequence, the planner not only chooses the optimal date 0 allocation but also the optimal date 1 allocation, which in turn directly provides the same for date 2, in contrast to Korinek and Sandri (2016) and Korinek and Dávila (2018).

Because the saver is unconstrained and hence behaves optimally[18], I focus on the behavior of the borrower that constitutes another difference between the paper and the two previous ones.

$$max U^B(c_0^B) + \beta \mathbb{E}_0 V^B(n_1^B, k_1^B) \quad \text{subject to (1.3) - (1.8), (1.14) and (1.18)} \tag{1.20}$$

where λ_t^{SP}, μ_t^{SP}, η_1^{SP} and ξ_t^{SP} denote the Lagrange multipliers for the social planner on the budget constraints, on the debt stock and flows collateral constraints and on the implementability constraints in period t, respectively. The optimal conditions for the social planner differ from the decentralized equilibrium in various ways.

First of all, the optimal conditions with respect to consumption of the homogenous good

$$\lambda_0^{SP} = U_0^{'B} - \underbrace{\xi_0^{SP} q_0 U_0^{''B}}_{Intra.\ arbitrage} \tag{1.21}$$

$$\lambda_1^{SP} = \beta \mathbb{E}_0(U_1^{'B}) - \underbrace{\xi_1^{SP} \mathbb{E}_0 \left[q_1 U_1^{''B} \right]}_{Intra.\ arbitrage} + \underbrace{\xi_0^{SP} \beta \mathbb{E}_0 \left[U_1^{''B}(F_1^{'B}(k_1^B) + q_1) \right]}_{capital\ accumulation} \tag{1.22}$$

$$\lambda_2^{SP} = \beta^2 \mathbb{E}_0(U_2^{'B}) + \underbrace{\xi_1^{SP} \beta \mathbb{E}_0 \left[U_2^{''B} F_2^{'B}(k_2^B) \right]}_{capital\ accumulation} \tag{1.23}$$

[18] Nevertheless, the potential asset fire sales could lead to redistribute wealth among the two types of agents, which are called *distributive externalities* and described in Korinek and Dávila (2018). For simplicity, I put aside this question and the associated potential distortions. See Jeanne and Korinek (2016) about ex-post policies financed by savers.

About the consumption at date 0, there is a wedge between the private (1.16) and social (1.21) conditions that the reflect marginal utility of consumption because the social planner includes the risk of potential asset fire sales and values more the capital good. Because of the implementability condition $\xi_t^{SP} > 0$ and $U_t^{''B} < 0$ for $t \in \{0, 1\}$, the consumption of homogenous good at date 0 is lower in the social planner allocation than in the decentralized equilibrium.

Consider now the differences between private (1.13) and social (1.22) conditions. The consumption at date 1 as defined by the social planner includes three new terms.[19] The first term follows the same logic as the ones defining the previous period. The second term represents the positive role of previous capital accumulation on the current consumption as well as in sales and in the function production. This effect is conditional on the degree of concavity in consumption. Finally, the net effect of these terms on the consumption at date 1 is uncertain and clearly depends on an intertemporal arbitrage. Rearranging (1.22) sheds light on the sign of the shadow values ξ_1^{SP} and ξ_0^{SP} on this issue.

$$\lambda_1^{SP} = \beta \mathbb{E}_0(U_1^{'B}) - \underbrace{(\xi_1^{SP} - \xi_0^{SP})\mathbb{E}_0\left[q_1 U_1^{''B}\right]}_{Inter.\ arbitrage} + \xi_0^{SP}\beta\mathbb{E}_0\left[U_1^{''B} F_1^{'B}(k_1^B)\right] \tag{1.24}$$

where $\xi_1^{SP} - \xi_0^{SP}$ means how the social planner relatively values the potential risk of asset fire sales in the two periods. If $\xi_1^{SP} < \xi_0^{SP}$, then the term that reflects this intertemporal arbitrage has the same sign as the effect of capital accumulation. Therefore, the social planner allocation increases the good consumption in period 1. But, if $\xi_1^{SP} > \xi_0^{SP}$, then the net impact of these terms is ambiguous, depending on the potential risk of asset fire sales versus the previous capital accumulation. It is also useful to contrast date 2 conditions (1.13) and (1.23), because of the social benefit due to higher capital accumulation at date 1.

[19] Substituting (1.16) into (1.13) yields the same first term in (1.22) and in (1.13). They reflect the private marginal utility of consumption and are discounted in the same way.

Furthermore, the optimal capital accumulation decisions according to the social planner allocation are

$$q_0 = \frac{\overbrace{\mathbb{E}_0\left[\lambda_1^{SP}(F_1'^B(k_1^B)+q_1)\right]}^{Externality\ term} + \overbrace{\xi_0^{SP}\beta\mathbb{E}_0\left[\lambda_1^{SP}F_1''^B(k_1^B)\right]}^{Decreasing\ returns}}{\lambda_0^{SP}-\Phi\mu_1^{SP}-\kappa\eta_1^{SP}} \tag{1.25}$$

$$q_1 = \frac{\lambda_2^{SP}\left[F_2'^B(k_2^B)+\xi_1^{SP}F_2''^B(k_2^B)\right]}{\lambda_1^{SP}-\Phi\mu_2^{SP}} \tag{1.26}$$

Again, the comparison between private (1.14)-(1.18) and social decisions (1.25)-(1.26) provides some differences in the two periods. First, the social planner creates some redistribution between consumption of good and capital, underlined as *Externality term* in equation (1.25). Second, this effect in favor of capital is balanced with decreasing returns to scale of the production function.

Finally, the Euler optimal conditions for bonds are close to those obtained in decentralized equilibrium.

$$\lambda_0^{SP} = \beta R_{01}\mathbb{E}_0(\lambda_1^{SP}) + \mu_1^{SP} + \eta_1^{SP} \tag{1.27}$$

$$\lambda_0^{SP} = \beta R_{02}\mathbb{E}_0(\lambda_1^{SP}) + \mu_1^{SP} \tag{1.28}$$

$$\lambda_1^{SP} = R_{12}\lambda_2^{SP} + \mu_2^{SP} \tag{1.29}$$

But the social planner allocation generates striking differences through changes in the Lagrange multipliers. So it affects the term premium denoted by $\rho^j := R_{02}^j - R_{01}^j$ where the superscript $j \in \{DE, SP\}$ distinguishes decentralized equilibrium (from condition (1.19)) from social planner.

$$\rho^{DE} = \frac{\eta_1^B}{\beta\mathbb{E}_0(\lambda_1^B)} \lessgtr \rho^{SP} = \frac{\eta_1^{SP}}{\beta\mathbb{E}_0(\lambda_1^{SP})} \tag{1.30}$$

where λ_1^{SP} is defined in equation (1.24). When the debt flow collateral constraint is slack, there is no risk premium in both cases. If I suppose a sufficient amount of short-term bonds, the risk premium between decentralized equilibrium and social planner is different, but with an ambiguous sign. For the above-mentioned reasons and with $\xi_1^{SP} > \xi_0^{SP}$ as a necessary condition, the risk premium of the social planner allocation could shrink down. The intuition is that if the debt flow collateral constraint is potentially binding at date 0 with too much short-term bonds, the planner

analyzes the risk of asset fire sales and forces the borrower to increase his position on long-term bonds. In other words, the social planner decides how to reallocate debt portfolio in order to avoir positive term premium.

1.4.2 Implementation via Taxes

Based on these differences, I highlight that a set of taxes and subsidies replicates the social planner allocation. They affect the debt level at date 0 and 1, in order to avoid an overborrowing case. They also provide capital good subsidies on the capital good. In fact, tipping the balance between consumption and capital goods in favor of the latter leads to reduced potential asset fire sales. The social planner implements (i) taxes on short-term bonds τ_0^{ST} and τ_1^{ST}, (ii) a tax on long-term bonds τ_0^{LT} and (iii) subsidies on capital good τ_0^k and τ_1^k, where $\tau > 0$ (< 0) reflects a tax (subsidy). The policy intervention assumes that government budget constraint is balanced at each period, with the presence of lump-sum transfers T^t. Because the uncertainty at date 0 only concerns the future potentially binding collateral constraint at date 1 and this latter is solved by the social planner, there is no time inconsistency problem.[20] The social planner is not forced to announce further taxes.

The borrower's budget constraints at date 0 and 1 are now

$$c_0^B + q_0(1+\tau_0^k)(k_1^B - k_0^B) + \frac{b_{01}^B}{R_{01}}(1-\tau_0^{ST}) + \frac{b_{02}^B}{R_{02}}(1-\tau_0^{LT}) + T_0 = e_0^B + b_0^B \tag{1.31}$$

$$c_1^B + q_1(1+\tau_1^k)(k_2^i - k_1^B) + \frac{b_{12}^B}{R_{12}}(1-\tau_1^{ST}) + T_1 = e_1^B + b_{01}^B + F_1^B(k_1^B) \tag{1.32}$$

Interest rates paid by borrowers increases with the level of the corresponding tax in line with the framework of Schmitt-Grohé and Uribe (2017). The corresponding lump-sum transfers/taxes only for borrowers are

$$T_0 = \tau_0^k q_0 k_1^B + \tau_0^{ST}\frac{b_{01}^B}{R_{01}} + \tau_0^{LT}\frac{b_{02}^i}{R_{02}} \tag{1.33}$$

$$T_1 = \tau_1^k q_1 k_2^B + \tau_1^{ST}\frac{b_{12}^B}{R_{12}} \tag{1.34}$$

[20] The potential break between policymaker's action under commitment and under discretion is widely debated. See Bianchi and Mendoza (2017) and Jeanne and Korinek (2016).

Taxes on Debt At date 0, the Euler equations for bonds become

$$\lambda_0^B(1-\tau_0^{ST}) = \beta R_{01}\mathbb{E}_0(\lambda_1^i) + \mu_1^i + \eta_1^i \tag{1.35}$$

$$\lambda_0^i(1-\tau_0^{LT}) = \beta R_{02}\mathbb{E}_0(\lambda_1^i) + \mu_1^i \tag{1.36}$$

By combining these new equations, the risk premium (1.19) and the social planner allocation conditions (1.21) and (1.22) on the consumption in periods 0 and 1, I obtain

$$\tau_0^{ST} = \tau_0^{LT} = 1-\beta\left[R_{01} + \underbrace{\frac{\eta_1^B}{\beta\mathbb{E}_0(\lambda_1^{SP})}}_{Risk\ prem.}\right]\mathbb{E}_0\left[\frac{\beta U_1'^B - (\overbrace{\xi_1^{SP}}^{Date\ 1}\ \overbrace{-\xi_0^{SP})q_1U_1''^B + \xi_0^{SP}\beta U_1''^B F_1'^B(k_1^B)}^{Ex-ante:\ pecuniary\ externality}}{U_0'^B \underbrace{-\xi_0^{SP}q_0U_0''^B}_{Ex-post}}\right] - \underbrace{\frac{\mu_1^B}{\lambda_0^{SP}}}_{Stock}$$

The set of taxes on short and long-term bonds are both macroprudential (i.e. *ex-ante*) and *ex-post* policies. The macroprudential component is represented by a large part of the numerator in the main fraction, underlined as *Ex-ante*. Following the previous condition (1.22) and the associated benefits of capital accumulation as well as in sales and function production, this pushes up both taxes on bonds, which in turn limits the risk of further binding collateral constraint. These taxes at date 0 are also negatively correlated to the shadow value ξ_1^{SP} of the next period's implementability constraint because it reflects the interest of ex-post policies in the next period. This balances the choice between ex-ante and ex-post policies period-by-period.

The *ex-post* component of these taxes reduces the risk of the current binding collateral constraint due to overconsumption. As suggested by condition (1.21), it supports high-level taxes and leads to a decrease in the good consumption in period 0. In addition, these policy interventions are state-contingent, because they are reduced in overborrowing cases, when one or two collateral constraints are binding.[21] This last argument is in line with the countercyclical capital controls as defined by Schmitt-Grohé and Uribe (2017).

Finally, there is no need to introduce a wedge between the two taxes. That does not mean that the bond maturity structure chosen by the agent is irrelevant, but he internalizes the set of taxes and chooses carefully the optimal mix between short and long-term bonds. With the incentives to

[21] The relevant values of μ and η from relaxing the collateral constraints are those of decentralized equilibrium and not of the social planner, because the set concerns a decentralized equilibrium with taxes and subsidies.

reduce the level of bonds, the agent focuses on the risk of binding debt flows collateral constraint when (i) the level of short-term bonds is too high in absolute terms and/or (ii) in relative terms. Specifically, the social planner alleviates the fiscal pressure on both short and long-term bonds when the debt flow collateral constraint is binding.

At date 1, the process is similar with the new Euler equation for bond

$$\lambda_1^B(1-\tau_1^{ST}) \quad = \quad R_{12}\lambda_2^B + \mu_2^i \quad \text{with} \quad \lambda_1^B = U_1^{'B} \quad \text{and} \quad \lambda_2^B = \beta U_2^{'B} \tag{1.37}$$

which provides the following tax on short-term bonds at date 1

$$\tau_1^{ST} \quad = \quad 1 - \mathbb{E}_1\left[R_{12}\frac{\beta^2 U_2^{'B} + \overbrace{\xi_1^{SP}\beta U_2^{''B}F_2^{'B}(k_2^B)}^{Interest\ next\ capital\ accumul.}}{\beta U_1^{'B} - \underbrace{\xi_1^{SP}q_1U_1^{''B}}_{Pecu.\ Externality} - \underbrace{\xi_0^{SP}q_1U_1^{''B} + \xi_0^{SP}U_1^{''B}F_1^{'B}(k_1^B)}_{Date\ 0:\ capital\ accumul.}}\right] - \underbrace{\frac{\mu_2^B}{\lambda_1^{SP}}}_{Stock} \tag{1.38}$$

Comparing the tax with the similar one in the previous period yields some similarities and calls for a *ex-post* policy intervention. The binding collateral constraint cuts the level of the tax, whereas the term on the benefits of further capital accumulation takes the opposite direction. The risk of overborrowing and asset fire sales play the same role. Furthermore, this tax includes a quite new negative term, that is related to the previous capital accumulation at date 0 due to the ex-ante policy.

Subsidies on Capital By using decentralized equilibrium condition (1.25) and the new optimal capital accumulation decision with the social planner policies, the tax/subsidy on the capital at date 0 is defined by

$$\tau_0^k \quad = \quad \frac{\mathbb{E}_0\left[(F_1^{'B}(k_1^B)+q_1)\left(\overbrace{(\xi_1^{SP}-\xi_0^{SP})q_1U_1^{''B}}^{Inter.\ arbitrage} - \overbrace{\xi_0^{SP}U_1^{''B}F_1^{'B}(k_1^B)}^{Intra.\ arbitrage}\right) - \overbrace{\xi_0^{SP}\beta\lambda_1^{SP}F_1^{''B}(.)}^{Decreasing\ returns}\right]}{q_0\lambda_0^{SP}} \tag{1.39}$$

and the tax/subsidy at date 1 is

$$\tau_1^k = \frac{\mathbb{E}_1\left[\beta U_2^{''B} F_2^{'B}(k_2^B)\left(\overbrace{\xi_1^{SP} F_2^{''B}(k_2^B)}^{Decreasing\ returns} + \overbrace{F_2^{'B}(k_2^B)}^{Capital\ accumulation}\right) + \beta^2 U_2^{'B} F^{''B}(k_2^B)\right]}{q_1 \lambda_1^{SP}} \quad (1.40)$$

These policies on capital complement taxes on debt to ensure that decentralized agents have no incentives to sell too much of their capital. At date 0, the equation (1.39) may be decomposed into three parts, following close previous arguments. First, this policy depends on the preference of the social planner for the two-periods risk of asset fire sales, which is measured by $\xi_1^{SP} - \xi_0^{SP}$. Second, this policy is affected by the degree of concavity in consumption. Finally, it is weighted by the production function and the efficiency limits due to decreasing returns to scale. To sum up, equation (1.39) generates a subsidy on capital ($\tau^k < 0$) if and only if the first term is sufficiently large and $\xi_1^{SP} > \xi_0^{SP}$. This means that the planner provides subsidies on capital when the capital accumulation is the key to avoid current and further asset fire sales. It is conditional on the function production efficiency and the agent's preference, while taxes on debt potentially sharply reduce the risk of fire sales. The same mechanism holds for subsidy at date 1 in equation (1.40).

1.5 Conclusion

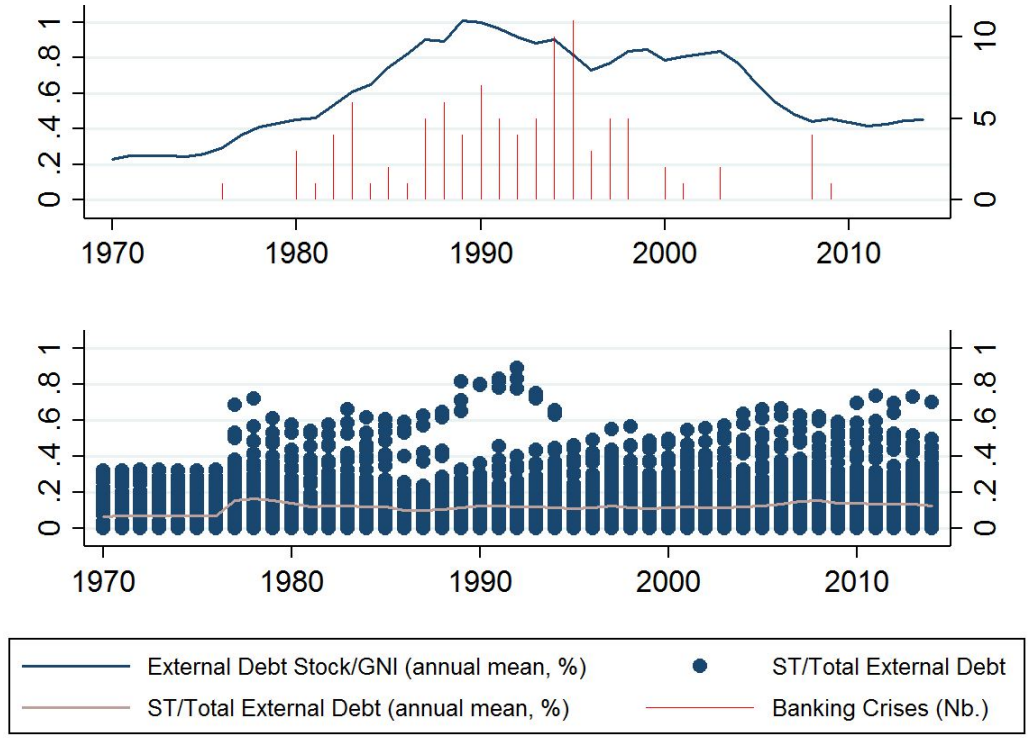
This paper underlines the role of debt maturity structure as a key early-warning indicator of financial crises for the developing world. This empirical evidence is then brought to the model. I introduce debt maturity structure in a *Fisherian deflation* model and I highlight that the mix of these debts chosen by a decentralized agent follows a suboptimal path. This mix could be too much oriented to short-term debt, but also too much oriented to long-term debt. The former triggers financial amplification mechanism in the next period, whereas the latter generates future binding collateral constraints over long horizons. The findings of this paper illustrate the importance of debt maturity structure for the occurrence of financial crisis. It makes harder the art of policymaking and calls for both ex-ante and ex-post policies.

This framework can be extended by including global financial forces, that is called the global financial cycle by Rey (2015). Clearly, the spillover effects from the US monetary policy are large,

because it drives global liquidity and this adds up to the high level of comovement in asset prices, credit, and risk aversion around the world. The global financial cycle can be seen in two phases: (i) boom with low US interest rates and high global liquidity and (ii) bust with high US interest rates and low global liquidity. These regime shifts are introduced into a *Fisherian deflation* model by Bianchi et al. (2016). The current framework that includes debt maturity structure can be enhanced to include these regime shifts. This affects the mix of short and long-term bonds chosen by the agent, which in turn could amplify the risk of asset fire sales. More precisely, if the world goes from a high-liquidity regime to a low-liquidity regime and if the borrower has previously accumulated too much long-term debt, both the likelihood and the amplitude of the financial crisis increase.

1.6 Supplementary Material

1.6.1 Stylized Facts



Sample of 122 countries (emerging and developing countries)

Figure 1.4: Debt stock, debt maturity structure and number of systemic banking crises

Table 1.5: List of countries

	Time Coverage		Time Coverage		Time Coverage
Afghanistan	2006-2012	Georgia	1993-2012	Pakistan	1970-2012
Albania	1991-2012	Ghana	1970-2012	Panama	1970-2012
Algeria	1977-2012	Grenada	1977-2012	Papua New Guinea	1976-2012
Angola	1989-2012	Guatemala	1970-2012	Paraguay*	1972-2012
Argentina*	1970-2012	Guinea	1970-2012	Peru	1970-2012
Armenia	1993-2012	Guinea-Bissau	1976-2012	Philippines*	1970-2012
Azerbaijan	1994-2012	Guyana	1972-2012	Romania	1980-2012
Bangladesh	1973-2012	Haiti	1975-2012	Russia*	1992-2012
Belarus	1993-2012	Honduras	1976-2012	Rwanda	1976-2012
Belize	1977-2012	India	1970-2012	Sao Tome	1978-2012
Benin	1970-2012	Indonesia*	1970-2012	Samoa	1974-2012
Bhutan	1985-2012	Iran	1980-2012	Senegal	1971-2012
Bolivia	1970-2012	Ivory Coast	1970-2012	Serbia	1970-2012
Bosnia	1999-2012	Jamaica*	1970-2012	Sierra Leone	1970-2012
Botswana	1973-2012	Jordan	1971-2012	Solomon Islands	1978-2012
Brazil	1970-2012	Kazakhstan*	1992-2012	South Africa	1994-2012
Bulgaria	1985-2012	Kenya	1970-2012	Sri Lanka	1970-2012
Burkina Faso	1977-2012	Kyrgyz Rep.	1993-2012	St. Lucia	1982-2012
Burundi	1977-2012	Lao PDR	1974-2012	St. Vincent	1981-2012
Cambodia	1986-2012	Lebanon	1977-2012	Sudan	1970-2012
Cameroon*	1970-2012	Lesotho	1976-2012	Swaziland	1977-2012
Cape Verde	1981-2012	Liberia	1971-2012	Syria	1970-2012
Central African Rep.	1970-2012	Macedonia, FYR*	1993-2012	Tajikistan	1993-2012
Chad	1970-2012	Madagascar	1973-2012	Tanzania	1970-2012
China*	1982-2012	Malawi	1970-2012	Thailand*	1970-2012
Colombia*	1970-2012	Malaysia*	1970-2012	Togo	1970-2012
Comoros	1976-2012	Maldives	1978-2012	Tonga	1985-2012
Congo, Dem. Rep.	1970-2012	Mali	1970-2012	Tunisia	1970-2012
Congo, Rep.	1970-2012	Mauritania	1971-2012	Turkey*	1970-2012
Costa Rica	1970-2012	Mauritius	1977-2012	Turkmenistan	1993-2012
Djibouti	1977-2012	Mexico	1970-2012	Uganda	1970-2012
Dominica	1981-2012	Moldova	1992-2012	Ukraine*	1992-2012
Dominican Rep.*	1970-2012	Mongolia	1992-2012	Uzbekistan	1992-2012
Ecuador	1970-2012	Montenegro	2006-2012	Vanuatu	1983-2012
Egypt	1970-2012	Morocco	1970-2012	Venezuela	1970-2012
El Salvador	1977-2012	Mozambique	1984-2012	Vietnam*	1987-2012
Eritrea	1995-2012	Myanmar	1973-2012	Yemen	1971-2012
Ethiopia	1970-2012	Nepal	1977-2012	Zambia	1970-2012
Fiji	1976-2012	Nicaragua*	1970-2012	Zimbabwe	1970-2012
Gabon	1970-2012	Niger	1971-2012		
Gambia, The	1977-2012	Nigeria*	1970-2012		

* corresponds to the subsample of 19 countries with currency mismatch data (Table 1.3 columns (5)-(8)).

Table 1.6: Data sources

Variable	Description	Source
	Crises	
Crises	Systemic banking crises. Dummy equal to 1 if crisis.	Laeven and Valencia (2012)
	International Debt Securities	
$\frac{ST}{ST+LT}$	Ratio of short-term external debt stock to all external debt stock. Short-term means disbursed outstanding debt with an original maturity of one year or less.	World Bank
$\frac{Debt\ Stock}{GNI}$	Ratio of external debt stock to gross national income. Decomposed into short (ST) and long-term (LT).	World Bank
$\frac{Debt\ Service}{GNI}$	Ratio of external debt service (payment of principal and interests) to gross national income. Decomposed into short (ST) and long-term (LT).	World Bank
	Global Financial Cycle	
FED rate	Percent, annual mean.	FED St Louis
VIX	Conventional measure of risk aversion based on S&P 500 index options. Proxy for uncertainty.	Bloom (2009) updated
Oil Price	World Crude Oil, US dollars.	Datastream
	Currency Mismatch Measures	
$\frac{Debt\ Stock\ (Service)}{Exports}$	Ratio of external debt stock (service) to all exports of goods, services and primary income.	World Bank
FXAGG	Aggregate foreign currency exposure. Bounded between -1 (highest level of currency mismatch risk) and 1 (no currency mismatch).	Bénétrix et al. (2015)
	Other Control Variables	
$\frac{Reserves}{Debt\ Stock}$	Ratio of international reserves to GDP, excluding gold.	World Bank
log(GDP)	GDP, current US dollars.	World Bank
$\frac{Private\ Credit}{GDP}$	Domestic credit to private sector as a share of GDP. It refers to financial resources provided to the private sector by financial corporations.	World Bank

1.6.2 List of Countries and Data Sources

1.6.3 Additional Tests

Table 1.7: Full set of results with individual lags - Table 1.1

	Dependent variable: Systemic Banking Crisis. Logit Estimates.								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
L. $\frac{ST}{ST+LT}$		3.526*			3.527*	5.892***	5.860***	7.325***	7.160***
		(1.927)			(1.917)	(2.109)	(2.112)	(2.567)	(2.550)
L2. $\frac{ST}{ST+LT}$		-5.215*			-4.790	-6.208*	-6.046*	-7.465**	-7.128*
		(3.076)			(3.082)	(3.238)	(3.277)	(3.754)	(3.698)
L3. $\frac{ST}{ST+LT}$		0.341			0.830	-0.395	0.0995	-1.210	-0.859
		(3.262)			(3.329)	(3.432)	(3.515)	(3.836)	(3.864)
L4. $\frac{ST}{ST+LT}$		-3.060			-2.669	-1.489	-0.812	-0.956	-0.212
		(3.146)			(3.199)	(3.309)	(3.367)	(3.534)	(3.601)
L5. $\frac{ST}{ST+LT}$		7.329***			6.755***	6.264***	5.957**	7.450***	7.285***
		(2.109)			(2.198)	(2.253)	(2.316)	(2.396)	(2.477)
L. $\frac{Debt\ Stock}{GNI}$			0.531**		0.582**		0.469*		0.389
			(0.261)		(0.294)		(0.266)		(0.254)
L2. $\frac{Debt\ Stock}{GNI}$			-0.209		-0.239		-0.287		-0.291
			(0.341)		(0.418)		(0.519)		(0.552)
L3. $\frac{Debt\ Stock}{GNI}$			-0.0899		-0.409		-0.538		-0.692
			(0.418)		(0.668)		(0.694)		(0.774)
L4. $\frac{Debt\ Stock}{GNI}$			0.0239		0.118		0.0300		-0.0284
			(0.426)		(0.623)		(0.648)		(0.710)
L5. $\frac{Debt\ Stock}{GNI}$			0.0743		-0.0302		0.143		0.218
			(0.301)		(0.424)		(0.459)		(0.467)
L. $\frac{Debt\ Service}{GNI}$				0.190	-1.125		-2.190		-1.853
				(3.485)	(3.997)		(4.694)		(4.795)
L2. $\frac{Debt\ Service}{GNI}$				1.401	1.031		0.550		1.115
				(3.041)	(3.110)		(3.410)		(3.381)
L3. $\frac{Debt\ Service}{GNI}$				3.988**	3.640*		4.835**		4.079*
				(1.806)	(2.114)		(2.141)		(2.255)
L4. $\frac{Debt\ Service}{GNI}$				2.042	3.242		4.381*		4.726
				(2.423)	(2.688)		(2.625)		(3.479)
L5. $\frac{Debt\ Service}{GNI}$				0.0757	2.084		2.166		-0.580
				(3.230)	(3.395)		(3.293)		(5.003)
L.FEDrate						-0.00836	0.00577		
						(0.0897)	(0.0923)		
L2.FEDrate						0.182	0.169		
						(0.128)	(0.132)		
L3.FEDrate						0.0537	0.0692		
						(0.128)	(0.132)		
L4.FEDrate						-0.0376	-0.0500		
						(0.121)	(0.124)		
L5.FEDrate						-0.129	-0.123		
						(0.0894)	(0.0914)		
L.VIX						-0.0185	-0.0182		
						(0.0183)	(0.0184)		
L2.VIX						-0.0578***	-0.0587***		
						(0.0223)	(0.0223)		
L3.VIX						-0.0162	-0.0205		
						(0.0173)	(0.0178)		
L4.VIX						-0.00136	-0.00480		
						(0.0197)	(0.0195)		
L5.VIX						0.00322	0.00216		
						(0.0205)	(0.0207)		
L.OilPriceMean						-2.839**	-2.734**		
						(1.337)	(1.354)		
L2.OilPriceMean						-3.050*	-3.056*		
						(1.690)	(1.698)		
L3.OilPriceMean						1.096	0.754		
						(1.750)	(1.770)		
L4.OilPriceMean						0.537	0.818		
						(1.620)	(1.672)		
L5.OilPriceMean						2.518**	2.134*		
						(1.130)	(1.193)		
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	No	No	No	Yes	Yes
Obs.	2351	2351	2351	2351	2351	2351	2351	2351	2351
Countries	68	68	68	68	68	68	68	68	68

Standard errors in parentheses. Following formal lag selection procedures, I consider 5 lags of all variables.
*, ** and *** denote respectively significance at the 1, 5 and 10% levels.

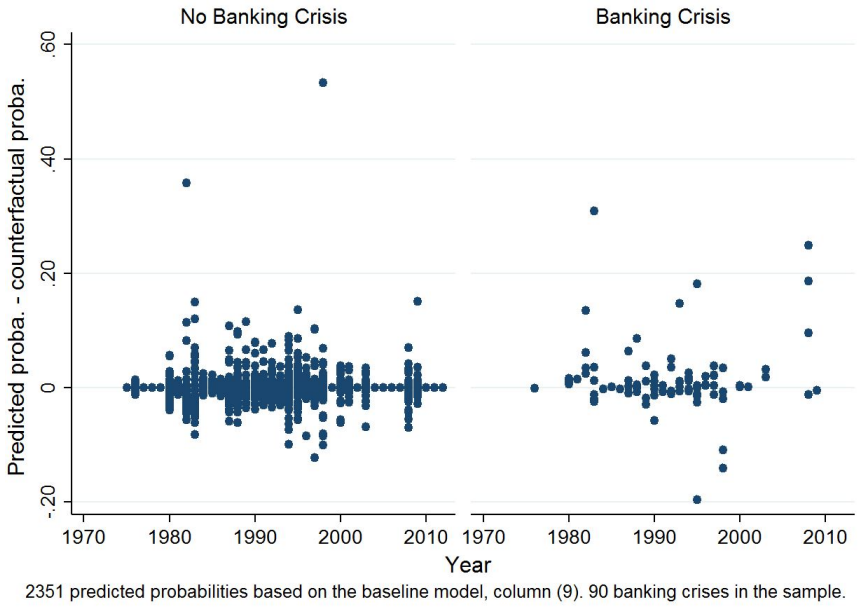


Figure 1.5: Difference between predicted and counterfactual probabilities

Table 1.8: External debt level and structure - OLS estimates

	Dependent variable: Systemic Banking Crisis. OLS Estimates.								
	Benchmark								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\frac{ST}{ST+LT}$		0.0701*			0.0680*	0.0629*	0.0653*	0.0582*	0.0593
Sum of lags		(0.0360)			(0.0392)	(0.0355)	(0.0391)	(0.0353)	(0.0392)
$\frac{Debt\ Stock}{GNI}$			0.0114**		0.00501		0.00278		0.00195
Sum of lags			(0.00524)		(0.00531)		(0.00554)		(0.00583)
$\frac{Debt\ Service}{GNI}$				0.191**	0.198**		0.122		0.0725
Sum of lags				(0.0876)	(0.0970)		(0.101)		(0.100)
FED rate						0.000592	0.000386		
Sum of lags						(0.00111)	(0.00120)		
VIX						−0.00187*	−0.00199*		
Sum of lags						(0.00103)	(0.00103)		
Oil Price						−0.0167*	−0.0155*		
Sum of lags						(0.00889)	(0.00932)		
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	No	No	No	Yes	Yes
Obs.	3683	3683	3683	3683	3683	3683	3683	3683	3683
Countries	121	121	121	121	121	121	121	121	121
R^2	0.0238	0.0278	0.0284	0.0265	0.0346	0.0421	0.0465	0.0575	0.0612
AUROC	0.758	0.793	0.786	0.786	0.807	0.853	0.853	0.882	0.829
Standard error	0.0188	0.0183	0.0173	0.0172	0.0169	0.0146	0.0145	0.0128	0.0175

Robust standard errors in parentheses. Following formal lag selection procedures, I consider 5 lags of all variables.

*, ** and *** denote respectively significance at the 1, 5 and 10% levels.

Table 1.9: Level versus changes - Sensitivity analysis

	Dependent variable: Systemic Banking Crisis. Logit Estimates.							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta \frac{ST}{ST+LT}$	-4.560			-4.482	2.022	1.912	1.006	0.468
Sum of lags	(5.202)			(5.441)	(5.518)	(5.785)	(5.975)	(6.270)
$\Delta \frac{Debt\ Stock}{GNI}$		1.091		1.110		0.258		-0.209
Sum of lags		(0.785)		(0.966)		(0.824)		(0.858)
$\Delta \frac{Debt\ Service}{GNI}$			2.359	-5.759		-0.178		0.749
Sum of lags			(13.98)	(15.87)		(15.56)		(16.67)
Δ FED rate					0.837***	0.841***		
Sum of lags					(0.266)	(0.268)		
Δ VIX					−0.233***	−0.240***		
Sum of lags					(0.0656)	(0.0666)		
Δ Oil Price					−21.68***	−21.46***		
Sum of lags					(4.212)	(4.263)		
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	No	No	Yes	Yes
Obs.	2265	2265	2265	2265	2265	2265	2265	2265
Countries	67	67	67	67	67	67	67	67
Pseudolikelihood	-284	-291	-291.3	-279.1	-254.3	-250.7	-219.2	-215.8
R^2	0.0336	0.00953	0.00846	0.0503	0.135	0.147	0.254	0.266
AUROC	0.618	0.572	0.542	0.642	0.757	0.761	0.821	0.822
Standard error	0.0305	0.0299	0.0316	0.0291	0.0224	0.0223	0.0175	0.0172

Standard errors in parentheses. Following formal lag selection procedures, I consider 5 lags of all variables.
*, ** and *** denote respectively significance at the 1, 5 and 10% levels.

Table 1.10: Other control variables - Sensitivity analysis

	Dependent variable: Systemic Banking Crisis. Logit Estimates.					
	(1)	(2)	(3)	(4)	(5)	(6)
$\frac{ST}{ST+LT}$	6.972***	4.093*	4.764*	2.668	3.036	5.487*
Sum of lags	(2.647)	(2.413)	(2.471)	(2.537)	(2.518)	(3.018)
$\frac{Reserves}{Debt\ Stock}$	−2.782**					−3.190**
Sum of lags	(1.275)					(1.460)
$\frac{IMF\ credit}{GNI}$		-5.479				-1.706
Sum of lags		(6.221)				(7.457)
$\frac{Multilateral\ credit}{GNI}$			−3.692*			-1.979
Sum of lags			2.023			2.334
$\frac{Private\ credit}{GDP}$				0.0331***		0.0276
Sum of lags				(0.0165)		(0.0197)
Log(GDP)					1.223*	1.274
Sum of lags					(0.629)	(0.824)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	1880	1880	1880	1880	1880	1880
Countries	58	58	58	58	58	58
Pseudolikelihood	-175.5	-181.3	-179.7	-177.4	-178.3	-163.1
R^2	0.301	0.278	0.284	0.293	0.290	0.350
AUROC	0.837	0.842	0.834	0.821	0.778	0.791
Standard error	0.0170	0.0170	0.0171	0.0178	0.0204	0.0200

Standard errors in parentheses. Following formal lag selection procedures, I consider 5 lags of all variables. *, ** and *** denote respectively significance at the 1, 5 and 10% levels.

Chapter 2

Structure of Income Inequality and Household Leverage: Theory and Cross-Country Evidence

How does income inequality and its structure affect credit? We extend the theoretical framework by Kumhof et al. (2015) to distinguish between upper, middle and low-income classes, and show that most of the positive impact of inequality on credit predicted by Kumhof et al. (2015) should be driven by the share of total output owned by middle classes. These theoretical predictions are empirically confirmed by a study based on a 41 countries dataset over the period 1970-2014. Exogenous variations of inequality are identified with a new instrument variable, the total number of ILO conventions signed at the country-level. Using various indicators of inequality, we support a positive impact of inequality concentrated on household leverage, and investigate how this average impact is distorted along income distribution. Consistently with the theoretical setting, our results tend to show that most of the impact is driven by middle classes, rather than low-income households. Consistently, our results hold mostly for developed countries.

2.1 Introduction

It has only been recently (less than a decade) that academic attention has been paid to the regular rise in both income and wealth inequalities. In this context, Atkinson, Piketty and Saez (see

Piketty, 2003, Piketty, 2014 or Atkinson et al., 2011) have made seminal contributions emphasizing the rise in the top income, and the concentration of wealth over the past 30 years, in developed but also in some emerging economies. Stiglitz (2012) warned of the huge cost of rising inequality in the US. Less expected has been the direct, causal relationship between those rising inequalities, the excess leverage of low- and middle-income households, and the financial crisis increasingly advocated by academic economists at the beginning of 2010. Debate entered the public sphere based on Rajan (2010)'s and Galbraith (2012)'s arguments that rising income inequality forced low- and middle-income households to increase their indebtedness in order to maintain their consumption levels.

Since then, this relationship has been the focus of a burgeoning academic literature. On the conceptual side, van Treeck (2014) and Bazillier and Hericourt (2016) survey different potential theoretical channels through which a rise in income inequalities[1] may endogenously have triggered an expansion of credit. An important issue relates to the type of income shock at stake. If income shocks are *transitory* and the volatility of transitory income is increasing (reflecting higher income inequalities in the short run), smoothing consumption through credit may be a rational answer for consumers facing a negative income shock. It is the theoretical framework chosen by Krueger and Perri (2006), Krueger and Perri (2011) or Iacoviello (2008) to analyze the link between inequalities and leverage or between income and consumption inequalities. But if income shocks are *permanent*, Piketty and Saez (2013) argue that households should adjust their consumption accordingly. If it is not the case, for instance if households cannot completely adjust their consumption to their income if the welfare loss induced by such a consumption cut is too large (Bertrand and Morse, 2016), the increase in leverage might lead to financial instability and possibly financial crises. Evidence from various countries tend to show that the rise of inequalities is more likely to be explained by permanent shocks.[2] Consistently with these stylized facts pointing to permanent income shocks associated with a long-term increase in between-group inequality, Kumhof et al. (2015) provide

[1] Consistently with the literature and the mechanisms at stake, in the remainder of the paper, inequality will refer to income inequality.

[2] On the US case, Kopczuk et al. (2010) show that income mobility decreased slightly since the 1950s. A decreasing social mobility is inconsistent with inequalities explained by *transitory* income shocks. Moffitt and Gottschalk (2002) and Moffitt and Gottschalk (2011) also find that the variance in transitory income declined or remained constant after 1980 unlike the variance in permanent income. Cappellari and Jenkins (2014) and Jenkins (2015a) reports very similar evidence (lack of changes in social mobility over time, decrease in income volatility observed) for the UK. On a cross-country perspective, Andrews and Leigh (2009) confirm this negative link between income inequality and social mobility over a larger sample of 16 countries. Similar evidence of an increase in between-group inequality, reflecting permanent income shocks, has also been found in emerging countries (see Ferreira and Litchfield, 2008 on Brazil; Kanbur and Zhuang, 2014 on some Asian countries including China, and India).

a formal discussion within a DSGE model relying on inequalities between household groups, and where a more unequal income distribution leads to higher leverage of low- and middle-income households; calibrated on US data, the framework replicates fairly well the profiles of the income distribution and the debt-to-income ratio for the three decades preceding the Great Recession.

On the empirical side, literature has also been scarce, and to some extent inconclusive. Based on quarterly US data from 1980 to 2003, Christen and Morgan (2005) find evidence consistent with a positive impact of inequality on household indebtedness, triggered by an increase in credit demand from individuals. Based on data of individual mortgage applications, still from the US, Coibion et al. (2014) find that low-income households in high-inequality regions borrowed relatively less than similar households in low-inequality regions. However, they do find a significant impact of the level of income on debt accumulation in both regions. On a cross-country-perspective, Bordo and Meissner (2012) rely on a panel of 14 mainly advanced countries for 1920 to 2008 to study the determinants of total bank credit growth using macroeconomic variables and the level of inequality measured by the 1% top income share. They find no significant relation between inequality and credit growth. However, based on a sample of 18 OECD countries over the period 1970-2007, Perugini et al. (2016) find very different results, concluding to a positive impact of income inequality on credit. Both studies do not use the same measure of credit (log of real bank loans to the private sector for Bordo and Meissner, 2012, credit over GDP for Perugini et al., 2016), but more importantly Perugini et al. (2016) provide an explicit treatment for the various endogeneity issues plaguing the relationship between inequality and credit.

These contradictory outcomes emphasize the difficulties inherent to the identification of a causal relationship between inequality and finance, due to the multiplicity of circular linkages and intertwined mechanisms - the latter are surveyed in Bazillier and Hericourt (2016).[3] Besides, the existing literature tend to focus almost only on the role of top incomes, which are opposed to a "bottom category" which actually mixed low and middle-incomes. This paper aims at filling these different gaps. To begin with, we provide an extension of Kumhof et al. (2015)'s framework, first by distinguishing explicitly between low and middle-class incomes, versus top incomes, and secondly, by

[3]They investigate various channels, which can be classified in two categories. On the one hand, demand-side arguments put emphasis on the proactive will of low/middle income household to maintain their consumption level relatively to the one of top income households. On the other hand, supply-side arguments emphasize the role of top incomes and of government, the former by savings and the latter in promoting the credit to those households with declining relative incomes.

identifying demand (in addition to supply) effects in the causal dynamics between inequality and credit. The model is then brought to the data to empirically investigate the existence of a causal relationship between inequality and the expansion of credit. As previously said, endogeneity is a major issue in the proper identification of such a relationship, as both variables are likely to be simultaneously determined by common shocks, and also due to the obvious reverse causality from finance to inequality. We propose a strategy based on variations in ratifications of International Labour Organization (ILO) at the country-level to predict exogenous changes of inequality, and estimate their effect on credit dynamics. Our approach relies on the exogeneity of the waves of ratifications at the international level in the 1970s and the 1990s, while controlling for the other standard macro determinants of credit. The strategy of ILO has changed over time. They have expanded their technical cooperation at the end of the seventies, and have adopted a strategy of active promotion of core labour standards and decent work in the nineties (see the conclusions of the Social Summit of Copenhagen in 1995 and the Declaration on Fundamental Principles and Rights at Work in 1998). Both evolutions have lead to a substantial increase in countries' ratification which is arguably orthogonal to country-specific developments. As the implementation of international labour standards has been shown to be inequality-reducing, this exogenous increase in ILO conventions' ratification allows us to identify the causal effect of inequalities on credit.

Our empirical analysis relies on a country-level yearly dataset for 41 countries over the period 1970-2014, based on two building blocks. Income inequality data come from World Income Inequality Database (WIID). Credit (household, aggregate, firm) come from various sources, such as the Bank of International Settlements, Central banks, OECD, Datastream. In both cases, data have been cleaned and harmonized through a transparent process which is detailed in the Data section. Besides, various robustness checks are implemented in order to ensure the stability of our estimates.

We find that an exogenous increase in inequality coming from ILO ratification shocks triggers an expansion of *household* credit. While Bordo and Meissner (2012) and Perugini et al. (2016) were focusing on total credit, we are able to show that this dynamic is driven by household credit which is consistent with theoretical intuitions. In addition, we show that the size of this effect varies substantially with the structure of income inequality. Starting with the Gini index (scaled between 0 and 1), which can be understood as a synthetic measure of inequality over the whole distribution, a one standard deviation increase is associated with a significant 7 percentage points

increase in the household credit to GDP ratio. Effects differ quite substantially when we focus on specific parts of the income distribution. When inequality is measured through the top incomes share, an increase by one standard deviation lifts credit to GDP ratio by 8.5 to 10.3%. Besides, and maybe more importantly, we show that this effect is substantially higher when middle incomes are concerned: when their share in total income increases by one standard deviation (meaning a *decrease* in the inequality of the distribution of income), credit to GDP decreases by 11.5 percentage points, whereas the same increase in low-income share cuts credit to GDP ratio by 6 percentage points. Similar effect can be found with income shares ratios: credit over GDP raises by 10% following a one standard deviation increase in the ratio of top over middle incomes, and by 7.7% following an equivalent increase for the ratio of top over bottom incomes. Therefore, we provide theory-based empirical evidence that inequality is a driver of household credit, not total private credit. Besides, we show that the middle of the income distribution is a key driver of this effect at the aggregate level, more than low incomes.

A substantial part of the paper is devoted to exploring the sensitivity of our results to robustness and falsification tests. The quantitative prevalence of middle classes in the positive link between inequality and credit is robust to various definitions of middle incomes. Consistently with theoretical intuitions, income inequality does not have any impact on the ratio of credit granted to firms over GDP. The positive impact of inequality is found again on ratios of total credit over GDP, which is consistent with Perugini et al. (2016)'s results; however, our own findings tend to show that this results on private credit is driven by credit to household. Besides, when we split our sample between developed and developing/emerging countries, we find that our results hold only for advanced countries, most inequality indicators displaying an insignificant impact on credit dynamics when the sample is restricted to developing countries. Once again, this is consistent with our result that most of the impact of income inequality on credit is driven by middle-class incomes. According to Kochhar (2015) who defines the middle and middle-upper classes as the group of individuals living with 10-50$ a day, they account for 15% of the population in Asia or 8% in Africa, against 60% in Europe or 39% in North America. One complementary explanation relies on financial market imperfections in developing countries. The poor and the middle income cannot respond to lower incomes by borrowing (Kumhof et al., 2012). Consistently with these intuitions, we find that emerging countries displaying a sufficient level of openness to international capital flows do exhibit

a positive impact of inequality on household credit. Conversely, there is not any impact of the Gini index on credit for countries with a low or limited level of openness. This goes again in the direction of a relaxation of credit constraints by incoming financial flows, allowing wider categories of population to access credit, and consequently, to react to variations in inequality. Finally, our results are mostly not impacted by the dynamics arising with the financial crisis and the Great Recession of 2007-2008.

Our work has important implications regarding financial crises prevention. Indeed, there is a bunch of recent academic papers supporting that household leverage (i.e. housing credit and short-term finance) is the main driving factor of banking and financial crises (see Buyukkarabacak and Valev, 2010; Jordà et al., 2013; Jordà et al., 2015; Jordà et al., 2016; Mian and Sufi, 2010a; Mian and Sufi, 2014b).[4] In order to avoid financial crises such as the one of 2007-2008, which triggered afterwards the Great Recession, one has therefore to prevent the creation of household leverage bubbles. Our findings suggest that the reduction of inequality is an important prerequisite of such a policy, especially at the middle of the income distribution. Hence, an implication of our results is that middle classes drive most of the financial cycle. This is consistent with a recent literature, like e. g. Gourinchas and Rey (2016) who show that the consumption to wealth ratio predicts real interest rates movements over the long run: periods of low consumption-wealth ratios are following periods of rapid asset price increases, subsequently followed by extended periods of low real (risk-free) interest rates.[5] That is consistent with our own idea of a permanent negative (positive) income shock for middle (high) incomes, which afterwards impacts aggregate credit.

The next section presents the model and the main theoretical predictions. Section 3 presents the data and some descriptive statistics. Section 4 details our empirical methodology and our identification strategy. Section 5 reports our baseline results and a number of robustness checks and falsification tests. The last section concludes.

[4] Using the database by Schularick and Taylor (2012) on 14 developed countries from 1870 to 2008, Kirschenmann et al. (2016) show that income inequality tends to be a better predictor of financial crises than bank loan growth. However, this does not mean inequality *directly* triggers financial crises, but merely that bank loans are not the best way to measure excessive leverage induced by income inequality. We will provide evidence throughout this paper that household credit is a more consistent and stronger candidate.

[5] Krishnamurthy and Muir (2017) also find that unusually low interest rate spreads, combined with unusual credit growth, are symptomatic of a credit market exuberance preceding a financial crisis.

2.2 The model

Our approach extends the model by Kumhof et al. (2015). In the latter, the economy is made of two kind of agents, top and bottom earners, corresponding roughly to the top 5% and bottom 95% in the US case. Therefore, bottom earners in Kumhof et al. (2015) involve *de facto* low and medium-income household. Our model consists of three groups of infinitely-lived households, referred to respectively as top earners, with population share χ_T, middle-class earners with χ_M and low-income earners with χ_L. Here, an increase of inequalities could be driven by rises in both incomes of top earners z^T and middle class z^M, or the rise in only one of them. As stressed by Atkinson and Morelli (2010), there is a potential heterogeneous role of income distribution changes.

Kumhof et al. (2015) highlights a supply-side mechanism through a wealth preference for top earners. We include in this framework a demand-side mechanism for bottom earners, following the literature surveyed in Bazillier and Hericourt (2016).

Total aggregate output y_t follows an autoregressive stochastic process around the steady-state $\overline{y}$. The share of output received by the three groups is also an autoregressive stochastic process and we test various cases about the shift in inequalities, from one group to another one or both groups. The model respects the following conditions

$$\chi^T + \chi^M + \chi^L = 1 \tag{2.1}$$

$$z_t^T + z_t^M + z_t^L = 1 \tag{2.2}$$

2.2.1 Middle Class Households

The representative middle class earner maximizes the intertemporal utility function

$$V_t^M = \mathbb{E}_t \sum_{k\geq 0}^{\infty} \beta_M^k \left[\frac{(c_{t+k}^M)^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}} + \gamma \frac{\left(\frac{1}{\chi^M} \frac{z_{t+k}^M}{b_{t+k}^M}\right)^{1-\frac{1}{\theta}}}{1-\frac{1}{\theta}} \right] \tag{2.3}$$

where β_M^k is the time-discount factor for middle-class earners and σ is the intertemporal elasticity of substitution. The first part of consumption preferences is the standard case of CRRA consumption

preference. The second part represents the credit demand-side mechanism in the spirit of Christen and Morgan (2005).[6] Since Veblen (1899) and Duesenberry (1949), it has been well-known that the overall level of satisfaction derived from a given level of consumption depends not only on the actual current consumption level but also on how it compares with some benchmark levels such as past consumption of some outside reference group ("*keeping up with the Joneses*" hypothesis). van Treeck (2014) argues that this is one of the main explanations for the relatively high consumption path of lower and middle-class households despite stagnation of their income.

We ensure that, all other things being equal, their share of ouput is positively linked to the utility function. The similar negative relationship holds for debt. γ is the weight of this effect and we assume that $\gamma > 0$. θ parameterize the curvature of utility function with respect to this demand-side effect. It works through the ratio of output share over credit. The desutility cost of new unit of debt increases with the share of output. If there are low inequalities that mean a high z^M, household is incited to sharply reduce his demand for loans. Conversely, this decreasing utility effect goes down when there is high inequalities with a low z^M. This mechanism provides a trade-off between consumption smoothing through debt and incentive effect through inequalities.

This intertemporal utility function is subject to the following budget constraint

$$c_t^M = y_t z_t^M \frac{1}{\chi^M} + b_t^M p_t^M - b_{t-1}^M \tag{2.4}$$

The first part is the per capita income of middle class households while the second part refers to debt flows: household receive b_t^M and reimburse b_{t-1}^M from previous debt contracted in period $t-1$. These debt flows are specific to Kumhof et al. (2015): when top earners lend to middle earners, they offer p_t^M units of consumption today in exchange for 1 unit of consumption tomorrow if middle earners do not default.[7] Similarly, when top earners lend to low-income earners, they offer p_t^L units of consumption, following the same mechanism. The smaller the amount p_t, the more expensive the implicit interest rate.

[6] Ahlquist and Ansell (2017) use a complementary approach, which is called positional good arguments. Bottom earners compare their consumption to the consumption of the rich, but it is made during only the first period in their model.

[7] A key feature of Kumhof et al. (2015) is endogenous default decision. We omit this default because we look for comparative statistics and, as noted by Kumhof et al. (2015), *"default has negligible effect on the Euler equations in the neighborhood of the original steady state."*. It is over the scope of this paper, but we can expect different penalty for defaults for low- and middle-income groups, which in turn affect trade-off about rational default decision.

Middle class earners maximize (2.3) subject to (2.4). Their optimal condition is as follows

$$p_t^M = \beta_M \mathbb{E}_t \left[\left(\frac{c_{t+1}^M}{c_t^M} \right)^{-\frac{1}{\sigma}} \right] + \gamma \left(\frac{z_t^M}{\chi^M} \right)^{\frac{\theta-1}{\theta}} \left(b_t^M \right)^{\frac{1-2\theta}{\theta}} (c_t^M)^{\frac{1}{\sigma}} \tag{2.5}$$

This condition highlights a trade-off between costs and benefits of a marginal increase of debt. Benefits are linked to intertemporal consumption choices while costs are explained by our specific demand-side argument. It holds only if $\theta > 1$. When z_t^M increases, indicating that inequalities around middle-incomes go down (that is, when the share of total income earned by middle-class households increases), p_t^M goes up. It means a reduction of middle class earners' demand with lower implicit interest rate. Symmetrically, an increase in inequalities implies higher implicit interest rate and consequently, higher demand for loans from middle-class earners. By comparison, Kumhof et al. (2015) provides a flat bottom earners' demand price as a function of debt, p_b. This demand-side effect also depends on the current consumption and debt. If we assume that $\theta > 0.5$, the increase in borrowing leads to a decrease of p_t^M, meaning a higher implicit interest rate, but high inequality dampen this effect.

2.2.2 Low-Income Households

Low-income households display the same behavior than middle-class ones. Their utility have the same functional form and the same elasticities σ and θ. The key difference is relative to the access of financial markets. They could be designed as a different supplier preference for loans to low- and middle-income groups. They could also be various discount factor[8] for the two kinds of borrowers.

Calculations similar as previously give this optimal condition

$$p_t^L = \beta_L \mathbb{E}_t \left[\left(\frac{c_{t+1}^L}{c_t^L} \right)^{-\frac{1}{\sigma}} \right] + \gamma \left(\frac{z_t^L}{\chi^L} \right)^{\frac{\theta-1}{\theta}} \left(b_t^L \right)^{\frac{1-2\theta}{\theta}} (c_t^L)^{\frac{1}{\sigma}} \tag{2.6}$$

Krueger and Perri (2006) show that income inequalities tends to be larger than consumption inequalities, due to consumption smoothing. Their argument is that *within group* income inequalities have grown much more than *within group* consumption inequalities. The idea that the rise

[8] We could assume that $\beta_L > \beta_M > \beta_T$ but this condition is not necessary. See Iacoviello (2005), among others.

of inequality is explained by a change of within-group inequality can be challenged. As we have seen, we have strong reason to believe that we observe a permanent shift explained by a rise in between-group inequalities. Nevertheless, the theoretical argument made by Krueger and Perri (2006) is interesting to understand why the rise of credit demand might be lower for the poor than for the middle-classes (beyond the credit market constraints argument). In their model, an efficient risk-sharing arrangement implies that "the currently rich agent has to transfer resources to the currently poor agent. To prevent this agent from defaulting, he needs to be awarded sufficiently high current consumption in order to be made at least indifferent between the risk-sharing arrangement and the autarkic allocation" (p. 173). The general idea is that the currently rich can become poor in the next period and *vice and versa*. This is perfectly consistent if inequalities are mainly observed within groups and not between groups. The size and the heterogeneity of the middle class make it more likely that *within middle-class income dynamics* might drive this behavior described in the Krueger and Perri (2006). This mechanism is not possible within poorest classes, for which the general tendency is likely to be more homogenous (and driven by between-groups inequality dynamics), making the theoretical argument of Krueger and Perri (2006) not plausible to analyze the split between income and consumption inequalities for this specific group.

2.2.3 Top Income Households

Top earners' utility from consumption has the same functional form and has the same parameter σ. By contrast with low- and middle-income earners, top earners provide loans to these two previous groups. This financial wealth is directly incorporated into their utility function, which implies a positive marginal propensity to save out of permanent income shock, following Carroll (2000) and Kumhof et al. (2015), among others. This wealth preference alters the arbitrage between consumption and debt in favor of supplying loans to other types of households. φ^L and φ^M are the weights of wealth in utility when top earners lend to low-income and middle-income earners, respectively. η parameterizes the curvature of the utility function with respect to wealth.

$$V_t^T = \mathbb{E}_t \sum_{k\geq 0}^{\infty} \beta_T^k \left[\frac{(c_{t+k}^T)^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}} + \varphi^L \frac{(1+\frac{\chi^L}{\chi^T}(b_{t+k}^L))^{1-\frac{1}{\eta}}}{1-\frac{1}{\eta}} + \varphi^M \frac{(1+\frac{\chi^M}{\chi^T}(b_{t+k}^M))^{1-\frac{1}{\eta}}}{1-\frac{1}{\eta}} \right] \tag{2.7}$$

We can write top earners' budget constraints as follows

$$c_t^T = y_t z_t^T \frac{1}{\chi^T} + \frac{\chi^L}{\chi^T}(b_{t-1}^L - b_t^L p_t^L) + \frac{\chi^M}{\chi^T}(b_{t-1}^M - b_t^M p_t^M) \tag{2.8}$$

The first part represents the per capita income of top earners. The second and third part are debt flows towards the two other household groups.[9] The first order conditions for b_t^M and b_t^L are logically close to the ones from Kumhof et al. (2015).

$$p_t^L = \beta_T \mathbb{E}_t \left[(\frac{c_{t+1}^T}{c_t^T})^{-\frac{1}{\sigma}} \right] + \varphi^L \frac{(c_t^T)^{\frac{1}{\sigma}}}{(1 + \frac{\chi^L}{\chi^T} b_t^L)^{\frac{1}{\eta}}} \tag{2.9}$$

$$p_t^M = \beta_T \mathbb{E}_t \left[(\frac{c_{t+1}^T}{c_t^T})^{-\frac{1}{\sigma}} \right] + \varphi^M \frac{(c_t^T)^{\frac{1}{\sigma}}}{(1 + \frac{\chi^M}{\chi^T} b_t^M)^{\frac{1}{\eta}}} \tag{2.10}$$

As suggested by Kumhof et al. (2015), these conditions reflects the trade-off between benefits and costs of acquiring an additional unit of financial wealth. In addition, we distinguish our supply-side argument: an increase in top earners' income share z_t^T in c_t^T leads to a decrease of implicit interest rate. They also suggest a no-arbitrage condition between loans to low-income earners and those to middle-class earners. It depends on the debt distribution among these two groups and their rational decision to default.

2.2.4 Equilibrium

In equilibrium the three groups maximize their respective lifetime utilities, the market for borrowing and lending clears and the market clearing condition for goods holds

$$y_t = \chi^T c_t^T + \chi^M c_t^M + \chi^L c_t^L \tag{2.11}$$

Two properties appear in equilibrium. First, the Euler equations (2.5), (2.6), (2.9) and (2.10) can be interpreted as the price of demand and supply of these loans while keeping their consumption

[9] $\frac{\chi_L}{\chi_T}$ and $\frac{\chi_M}{\chi_T}$ are explained by per capita wealth transfers.

constant. The following condition holds

$$b^i_{t-1} - b_t p_t = b^i(1 - p^i(b^i)) \tag{2.12}$$

So the optimal consumption of the three groups change with $\overline{y}$ as output in steady-state. There are given by

$$c^T = \overline{y}\overline{z^T}\frac{1}{\chi^T} + \frac{\chi^L}{\chi^T}(b^L(1 - p^L(b^L))) + \frac{\chi^M}{\chi^T}(b^M(1 - p^M(b^M))) \tag{2.13}$$

$$c^M = \overline{y}\overline{z^M}\frac{1}{\chi^M} + \frac{1}{\chi^M}b^M(p^M(b^M) - 1) \tag{2.14}$$

$$c^L = \overline{y}\overline{z^L}\frac{1}{\chi^L} + \frac{1}{\chi^L}b^L(p^L(b^L) - 1) \tag{2.15}$$

Second, we look for the neighborhood of the steady-state. Therefore, we simplify these demands and supplies to yield

$$p^L(b^L) = \beta_L + \gamma\left(\frac{\overline{z^L_t}}{\chi^L}\right)^{\frac{\theta-1}{\theta}}\left(b^L_t\right)^{\frac{1-2\theta}{\theta}}(c^L_t)^{\frac{1}{\sigma}} \tag{2.16}$$

$$p^L(b^L) = \beta_T + \varphi^L\frac{(c^T)^{\frac{1}{\sigma}}}{(1 + \frac{\chi^L}{\chi^T}b^L)^{\frac{1}{\eta}}} \tag{2.17}$$

$$p^M(b^M) = \beta_M + \gamma\left(\frac{\overline{z^M_t}}{\chi^M}\right)^{\frac{\theta-1}{\theta}}\left(b^M_t\right)^{\frac{1-2\theta}{\theta}}(c^M_t)^{\frac{1}{\sigma}} \tag{2.18}$$

$$p^M(b^M) = \beta_T + \varphi^M\frac{(c^T)^{\frac{1}{\sigma}}}{(1 + \frac{\chi^M}{\chi^T}b^M)^{\frac{1}{\eta}}} \tag{2.19}$$

We aim to obtain same steady state relationships as Kumhof et al. (2015) but we cannot simply drop the price because of supply-demand equality. By contrast, our extension gives two debt levels $(\overline{b^M}, \overline{b^L})$ with their prices $(\overline{p^M}, \overline{p^L})$. We combine equations (2.13) to (2.19)[10] and we differentiate these relationships to have a causal impact.

To highlight the demand-side argument, we can derive the effect of an increase in low- and middle classes' income share $\overline{z^i}$ on the steady-state debt level $\overline{b^i}$ for $i \in (L, M)$ and $i \neq j$,

[10]Because these equations are interlinked, we do not present direct steady-state relationship as equation (17) in Kumhof et al. (2015). But the balance of supply and demand of both kinds of credit suggest positive loans as long as these conditions $\beta_M > \beta_T$ and $\beta_L > \beta_T$ are satisfied.

$$\frac{\mathrm{d}log(\overline{b^i})}{\mathrm{d}log(\overline{z^i})} = -\frac{\overbrace{\frac{\theta-1}{\theta}\frac{\gamma}{\overline{z^i}}}^{Demand\ Side} + \overbrace{\frac{1}{\sigma}\frac{1}{\chi^i}\frac{\overline{y}}{\overline{c^i}}}^{KRW(2015)}}{\underbrace{\frac{1-2\theta}{\theta}\frac{1}{\overline{b^i}}}_{Borrower\ pref.} + \underbrace{\frac{1}{\eta}\frac{\frac{\chi^i}{\chi^T}}{1+\frac{\chi^i}{\chi^T}\overline{b^i}}}_{CRRA} - \underbrace{\frac{1}{\sigma}\frac{1}{\chi^i}\frac{1-\overline{p^i}}{\overline{c^i}}}_{quantity\ vs\ price} - \underbrace{\frac{1}{\sigma}\frac{\chi^i}{\chi^T}\frac{\overline{p^i}}{\overline{c^T}}(\varphi^i-\varphi^j)}_{Top\ income\ pref.}} \tag{2.20}$$

This equation exhibits a negative effect if $\theta > 1$ and if the denominator is globally positive. We disentangle this latter into four terms. The first directly comes to the borrower preference in equation (2.5). The second and the third parts are close to the equation (18) of Kumhof et al. (2015) and respectively represent a specific CRRA function effect and the trade-off between price and quantity for loans. A decrease in inequality through the rising part of borrowers' income share could negatively affect interest rates, more than credit quantity. The final part reflects the top income household's preference on wealth and how they choose between credit to low- and middle-income households. To sum up, if implicit interest rate is not too high and if the discrimination between borrowers' groups is limited, the denominator is positive. In addition, our model allows to define the cross derivative exercise, that measures the responsiveness of the loans demanded by a borrower's group to a change in the income share of the other borrower's group. As described in Supplementary Material 2.7.1, the impact is positive if the demand-side argument works.

To show the supply-side argument, we proceed the same way with an increase of top earners' income share $\overline{z^T}$,

$$\frac{\mathrm{d}log(\overline{b^i})}{\mathrm{d}log(\overline{z^T})} = \frac{\frac{1}{\sigma}\frac{1}{\chi^T}\frac{\overline{y}}{\overline{c^T}}(\varphi^i-\varphi^j)}{\frac{1-2\theta}{\theta}\frac{1}{\overline{b^i}} + \frac{1}{\eta}\frac{\frac{\chi^i}{\chi^T}}{1+\frac{\chi^i}{\chi^T}\overline{b^i}} - \frac{1}{\sigma}\frac{1}{\chi^i}\frac{1-\overline{p^i}}{\overline{c^i}} - \frac{1}{\sigma}\frac{\chi^i}{\chi^T}\frac{\overline{p^i}}{\overline{c^T}}(\varphi^i-\varphi^j)} \tag{2.21}$$

If the denominator is again positive and if top income household discriminates in favor of this specific borrowers' group, the supply-side argument holds.

2.2.5 Testable Predictions

We can derive from this short theoretical exercise three main theoretical predictions, that we will subsequently bring to the data:

Testable Prediction 1: An increase in inequality leads to an expansion on household credit at the aggregate level. This is consistent with both Kumhof et al. (2015) and our own setting. Here, it is the combination of a demand-side effect (equation 2.20) and a supply-side effect (equation 2.21).

Testable Prediction 2: The bulk of the positive impact of inequality on household credit is driven by middle classes. This quantitative result depends on three factors developed in Supplementary Material 2.7.1, that is (i) the debt provided to middle-class is sufficiently higher than the debt provided to low-income households, (ii) there is some discrimination against the poorer ones and (iii) the pass-through to implicit interest rate of an inequality shock is not too high.

Testable Prediction 3: The positive causal link from inequality to household credit exists if and only if the country is sufficiently developed. As developed by Kumhof et al. (2012), the credit constraints are so high in emerging world that potential borrowers' groups have a little access to domestic financial markets and no access to international ones. In these countries, top income households *"deploy their surplus funds abroad, leading to current account surpluses"*, which drop current wealth preference, i.e. the parameters φ^L and φ^M are equal to 0.

2.3 Data

Our empirical analysis relies on a country-level yearly dataset for 41 countries over the period 1970-2014, based on two building blocks, income inequality and credit.

2.3.1 Inequality

The use of inequality data in cross-countries studies raises several challenges. The use of one specific index of inequality and one specific database is not neutral. Jenkins (2015b), among others, show how it can have major implications on empirical results. One contribution of this paper is to rely on several alternative indexes of inequalities focusing on different part of the income distribution. Furthermore, we apply a very rigourous process to choose the relevant primary source in order to ensure comparability among countries.

Bordo and Meissner (2012) and Perugini et al. (2016), among others, use top income shares from the World Top Income Database (WTID). This database built by Alvaredo et al. (2014) is available for 31 countries with high time coverage for some countries. It uses fiscal data and is based

on *pretax* income. The main advantage of this database is that it provides much better estimates of the tail of income distribution (top 1% and beyond). However, one serious limitation is that it is based on pre-tax income and not *disposable* income. As we would like to focus on saving and borrowing behaviour of households, it represents a serious drawback as these data do not take into account the effect of fiscal redistribution on the disposable income. Also, by definition, this database only focus on top incomes. Leigh (2007) admittedly argues that "*panel data on top income shares may be a useful substitute for other measures of inequality over periods when alternative income distribution measures are of low quality, or unavailable.*" (p. 619). However, one condition has to be fulfilled: factors affecting inequalities should have an impact on both the top and the bottom of income distribution. In our case, it is not likely to be the case. As stated by Atkinson and Morelli (2010) in the context of banking crises, "*different parts of the income distribution react differently , and the conclusions drawn regarding the origins and the impact of the crisis may depend which part of the parade we are watching. The top and the bottom may be the most affected; depending on the theoretical model adopted, either the top or the bottom may be more relevant to understand the origins of the crisis*" (p. 66). Here, our aim is to focus on the potential heterogenous role of different shocks along the income distribution on the inequality-credit relationship. Any distributional change *within* the bottom 90% will not be captured by top income share indexes.

By contrast with the literature, we consequently focus on different indexes of inequalities, namely: the Gini coefficient, income shares per decile, as well as ratios between those income shares. The use of the Gini index will give a more general picture as it takes into account the whole distribution of income and not only the dynamics at both tails. Afterwards, we go one step deeper by investigating the impact of different income shares categories: the top incomes, alternatively defined as the share of income owned by the Top 10 (corresponding to incomes after the 9^{th} decile) and Top 30% (corresponding to incomes after the 7^{th} decile); the middle class incomes, defined alternatively as Middle 30-70% (corresponding to incomes after the 3^{rd} and up to the 7^{th} decile) and Middle 30-90% (corresponding to incomes after the 3^{rd} and up to the 9^{th} decile); the bottom incomes, defined as the share of income owned by the Bottom 30% (corresponding to incomes up to the 3^{rd}). Finally, we complement by using ratios of these different shares, in order to assess the impact of relative variations, i.e. gain or impoverishment of one category versus another one.

More precisely, we study the impact of the ratio of Top incomes over Middle class incomes (Top 10/Middle 30-90, and Top 30/Middle 30-70), and Top Incomes over Bottom incomes (Top 10/Bottom 30, and Top 30/Bottom 30).[11] More generally, the detailed analysis with income share per decile allows us to disentangle the specific effect of income shocks for the poorest and income shocks for the middle-class. This will allow us to test some implications of the theoretical model. More specifically, if lower incomes are highly credit-constrained, i.e. if they have a more difficult access to credit, income dynamics of the middle-class is more likely to have an effect on credit dynamics.

For the Gini index and statistics per decile, we follow Jenkins (2015b), recommending the use of the World Income Inequality Database (WIID) instead of the Standardized World Income Inequality Database (SWIID). The former has updated and extended the Deininger and Squire (1996) database and corrected some of the inconsistencies pointed out by Atkinson and Brandolini (2001, 2009). It also includes new estimates from National Survey statistics, TransMonEE (2011), the Commitment to Equity Project (CEQ) ,the Socio-Economic Database for Latin America and the Caribbean (SEDLAC, 2016), the Luxembourg Income Study, OECD and EUROSTAT. It covers 161 countries between 1867 and 2015. By comparison, the SWIID from Solt (2009) has broader coverage than the WIID, with a lower number of missing observations. We choose not to use this data, mostly because of potential problems raised by the imputation procedure that is used to fill missing data in the WIID.[12]

We provide a transparent process to use WIID rigorously. The use of several data types (gross versus net income data, household versus individual income data and income versus expenditure data) may alter the comparability of the inequality measures (Atkinson and Brandolini, 2001, Jenkins, 2015b), so it is necessary to use comparable data across sources. Our rules of selection ensure high quality data within and between countries. We keep only observations with specific characteristics: they are coded as high (or medium) quality, and they concern post-tax income. They are also consistent according to the income share unit, the unit of analysis, the geographical, age and population coverages and they employ similar equivalence scale. Our selection promotes the use of one unique dataset but also provides arguments in favor of some datasets mix. To

[11] Note that these ratios are intuitively closed to the Palma (Palma, 2011) index that combines the top 10% income share with the bottom 40% income share.

[12] This debate falls within the trade-off between the geographical coverage and the reliability of the data. See Jenkins (2015b) and Solt (2015).

ensure high quality, we generally prefer to use only one dataset.[13] In some cases, we face a trade-off between the use of one particular dataset with potential linear interpolations and the use of multiple datasets, especially when these datasets come from the same institutions. We combine datasets if and only if the risk of structural break is very low.[14] Supplementary Material 2.7.2 summarizes the primary sources used for each country. 19,5 percent (**8** countries[15] out of 41) of our sample use series mixing different primary sources.

2.3.2 Credit

By contrast with the existing works based on cross-country samples, we refer to household credit[16] but there is no unique data source according to our time and geographical coverages. Data reported by different sources may exhibit discrepancy under mutually consistent definitions. We build a general data map to ensure comparability and to achieve a reliable identification of the link between household credit and inequality. Household credit is much more relevant to analyze the potential effect of inequalities. There is no theoretical mechanism to explain the potential effect on other sources of private credit such as business credit. In addition, Buyukkarabacak and Valev (2010) find that business credit is a much weaker predictor of financial crises.

Our main datasource for household credit is the Bank for International Settlements (BIS): Over 87% (36 countries) of household credit directly comes from BIS. The remainder of household credit data comes from Central Banks and Oxford Economics from Datastream, and has been carefully checked and harmonized (see Supplementary Material 2.7.2). Note that aggregate private credit computed by the BIS involves loans from both domestic and international financial sector. In robustness checks, we check how inequality impacts total credit to the private sector, using the corresponding variable form the BIS database, and also two alternatives indexes from the World Bank (WB), which are restricted, respectively, to private credit from domestic financial sector, and from domestic banks. We also use credit granted to private firms as a falsification test, since the

[13] In some limited cases, we fill missing data by using a linear interpolation. We use this technique only if the time span between two observations is limited.

[14] These following conditions should be met: (1) same (or very close) definition of welfare; (2) same share unit; (3) same unit of analysis; (4) same equivalence scale; (5) the Gini and deciles should follow same trends before and after the risk of structural break, (6) the Gini should be similar in the year of matching the two datasets.

[15] Austria, Belgium, Finland, Ireland, Portugal, Sweden. We also use different datasources for South Korea and United Kingdom for various decades but without any interpolation across years.

[16] Bordo and Meissner (2012) use the log of bank credit to the private section, and Perugini et al. (2016), the ratio of total private credit to GDP.

theoretical underlying intuitions do not imply it will be impacted by inequality.

We investigate the impact of inequality on the ratio of (household) credit to GDP, following Perugini et al. (2016). Indeed, the recent literature (see e.g. Atkinson and Morelli, 2015) emphasize that it is the excessive level of credit compared to output that may lead to financial instability. Increasing levels of credit do not imply instability if productive investment is funded, triggering an increase in the long-run output: In other words, we are not that much interested in the growth of credit *per se*, but by the share of the latter which creates potentially an increased macroeconomic risk, i.e. which does not translate in a corresponding increase in potential output. This is why we focus on the use of credit as a percentage of GDP. However, we also check in additional estimates how our results behave when we use the log of household credit.

2.3.3 Other variables

The classical determinants of credit pointed by the literature are financial liberalization, monetary dynamics and the level of economic development. Regarding financial liberalization, we use indexes of credit market deregulation provided by the Fraser Institute.[17] They are widely employed in the literature, notably Giannone et al. (2011) and Stankov (2012). We employ the summary index derived from the private ownership of banks, the existence of interest rate controls and negative interest rates, and the extent to which government borrowing crowds-out private borrowing.

Monetary dynamics are a key determinant of credit in various theoretical contexts. We proxy the monetary environment by broad money supply, i.e. M2/GDP ratio from World Bank, following the previous literature, notably Elekdag and Wu (2011) and Perugini et al. (2016). The level of economic development also impacts the depth of the domestic financial system on the one hand and the level of the *financial exclusion* frontier in the favor of French et al. (2013) on the other hand. We use the standard proxy, GDP per capita, provided once again by the World Bank.

[17] Data available at https://www.fraserinstitute.org/

2.4 Empirical methodology

2.4.1 Baseline specification

Our main objective is to identify how inequality, and its structure, affect the household credit at the country-level. In general, we want to estimate a specification of the following form

$$Credit_{i,t} = \beta Ineq_{i,t} + \Gamma X_{i,t} + \mu_i + \lambda_t + \epsilon_{i,t} \tag{2.22}$$

where $Credit_{i,t}$ and $Ineq_{i,t}$ are respectively the household credit over GDP and inequality in country i during year t. Inequality impact will be assessed through various measures (Gini and Palma indexes, deciles of income) in order to enlighten the role of the structure of income distribution. $X_{i,t}$ is a vector of controls including M2/GDP, log(GDP per capita) and the index of financial deregulation. μ_i denotes country-specific fixed effects, and λ_t represent year dummies. The former captures all time-invariant country characteristics and the latter common trend and shocks, in particular common business cycle conditions. We are specifically interested in changes in credit driven by exogenous variations in inequality. Our coefficient of interest is β: our model predicts $\beta > 0$ when inequality rises, i.e. when the Gini index and the share of top incomes (top 10%, top 30%) in the total income increases, or when the share of low and middle incomes decrease.

Table 2.1 below shows the results obtained when equation 2.22 is estimated by OLS. Column (1) reports the estimated coefficient when inequality is proxied through the Gini index. Columns (2) to (6) use alternatively different deciles of income, distinguishing between the rich (*Top 10* and *Top 30*), the middle classes (corresponding either incomes after the 3rd and up to the 9th decile, denominated *Mid. 30-90%*, or to incomes after the 3rd and up to the 7th decile, *Mid. 30-70%*). Finally, columns (7) to (10) rely on ratio between top incomes and middle and lower incomes. Note that reported coefficients have been standardized in order to ease comparisons. Table 2.1 echoes the findings of Bordo and Meissner (2012), who find insignificant correlations when using a similar specification - but with log of credit as a dependent variable.

Table 2.1: OLS specification

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Dependent variable: Household Credit/GDP									
Inequality Measure	Gini	Top10	Top30	Mid. 30-90	Mid. 30-70	Bottom	Top10/Mid39	Top10/Bot	Top30/Mid37	Top30/Bot
Inequality	0.0780	0.129	0.0944	-0.153	-0.152	0.00920	0.150	0.210	0.157	0.199*
	(0.124)	(0.139)	(0.133)	(0.143)	(0.150)	(0.116)	(0.150)	(0.128)	(0.154)	(0.115)
GDP per capita	0.0754	0.0864	0.0813	0.108	0.102	0.0770	0.0910	0.0906	0.0926	0.0850
	(0.219)	(0.228)	(0.221)	(0.245)	(0.237)	(0.216)	(0.230)	(0.219)	(0.227)	(0.216)
Broad Money Ratio	0.222*	0.217*	0.221*	0.220*	0.218*	0.236**	0.217*	0.218*	0.221*	0.218*
	(0.113)	(0.113)	(0.113)	(0.112)	(0.113)	(0.111)	(0.113)	(0.112)	(0.112)	(0.112)
Credit Dereg.	-0.0676	-0.0698	-0.0690	-0.0658	-0.0704	-0.0603	-0.0684	-0.0729	-0.0694	-0.0746
	(0.0896)	(0.0911)	(0.0901)	(0.0895)	(0.0908)	(0.0866)	(0.0909)	(0.0917)	(0.0910)	(0.0913)
Cons.	-1.803	-1.910	-1.862	-2.144	-2.072	-1.837	-1.960	-1.947	-1.978	-1.886
	(2.285)	(2.379)	(2.310)	(2.561)	(2.476)	(2.262)	(2.394)	(2.284)	(2.362)	(2.245)
Obs.	896	896	896	896	896	896	896	896	896	896
Countries	41	41	41	41	41	41	41	41	41	41
adj. R^2	0.661	0.663	0.662	0.666	0.664	0.661	0.664	0.668	0.664	0.667

All coefficients are standardized, except the log(real GDP per capita).
Robust standard errors in parentheses.
Country and Year Fixed Effects.
*, ** and *** denote respectively significance at the 1, 5 and 10% levels.

However, a number of reasons may lead these OLS estimates to be heavily biased. First, credit and inequality are likely to be simultaneously determined by shocks, such as the deregulation waves in the 1980s and the 1990s[18], which increased simultaneously the two variables; in that case, β is positively biased. We reduce the bias by controlling for financial liberalization, but other dimensions and shocks might still be at play. Another obvious issue relates to reverse causality: credit is very much likely to have an impact on inequality, even if the direction and size of the impact are quite debated in the literature (see Bazillier and Hericourt, 2016), making the extent and sign of the bias on β uncertain. Finally, Table 2.2 below shows that credit is much more volatile than inequality (as embodied by the Gini index): the standard deviation of the growth rate of our preferred indicator, the ratio of household credit over GDP is ten times higher than the one of Gini. For the growth rate of household credit, standard deviation is still a bit less than three times higher. This creates an attenuation bias driving β towards zero, and may be due to the fact that country-level idiosyncratic shocks on these variables are probably not the same. All these reasons imply that the sign and significance we obtain for β in Equation 2.22 when estimated by OLS is unclear.

[18] As the deregulation wave occurs simultaneously in most developed countries, part of this effect is captured through the time dummies. However, differences in the timing of financial deregulation may still bias our OLS estimates.

Table 2.2: Descriptive statistics: credit and inequality

	Mean	First quartile	Median	Third quartile	S.D.*within*
Levels					
Gini	0.340	0.270	0.318	0.372	0.019
Top 10	0.268	0.218	0.244	0.282	0.016
Top 30	0.537	0.481	0.517	0.563	0.015
Middle 30-90	0.60	0.594	0.617	0.629	0.011
Middle 30-70	0.332	0.322	0.347	0.361	0.009
Bottom 0-30	0.131	0.111	0.135	0.158	0.007
Top 10/Middle 30-90	0.461	0.350	0.394	0.473	0.039
Top 30/Middle 30-70	1.706	1.337	1.487	1.740	0.125
Top 10/Bottom 0-30	2.515	1.375	1.801	2.527	0.407
Top 30/Bottom 0-30	4.800	3.025	3.851	5.017	0.582
Household credit/GDP	0.431	0.189	0.416	0.593	0.143
log(real household credit)	6.673	5.093	6.470	7.501	0.757
ILO Conv.	63.66	41	67	86	6.60
Variations					
d.Gini	0.0004	-0.003	0.001	0.0037	0.007
d.(household credit/GDP)	0.013	-0.001	0.01	0.025	0.026

2.4.2 Identification strategy

To identify how variations in inequality driven by exogenous shocks affect household credit over GDP, we need an instrument that impacts inequality without influencing directly credit (exclusion restriction), and that is orthogonal to any country-specific characteristics which may have driven simultaneously both variables (inequality and credit). This notably excludes indicators of labour market flexibility and institutions. Indeed, labour market and financial liberalization often belong to the same policy package, with two consequences: an increase in the demand for credit due to the fall in workers' bargaining power, and an increase in credit supply explained by financial liberalization (see Tridico, 2012).

Therefore, we propose to exploit exogenous changes in the policies of the International Labour Organization. These changes were largely exogenous to specific country characteristics but had a direct impact on the number of ILO conventions ratified by a country. We will show that the ratifications of ILO conventions are likely to be correlated with the country-level of inequality. In other words, we propose to rely on a "quasi-natural experiment" environment provided by the strategy of the International Labour Organization. In normal times, one can argue that the ratification of ILO conventions is likely to depend on countries characteristics, which will violate the

exclusion restriction in our identification strategy. However, we identify two waves of ratifications that are likely to be exogenous to these national characteristics. As we can see on the following page, the first wave of increase starts in the mid-seventies and the second one in the nineties. We detail below the reasons why these two waves are very likely to be exogenous to countries' characteristics.

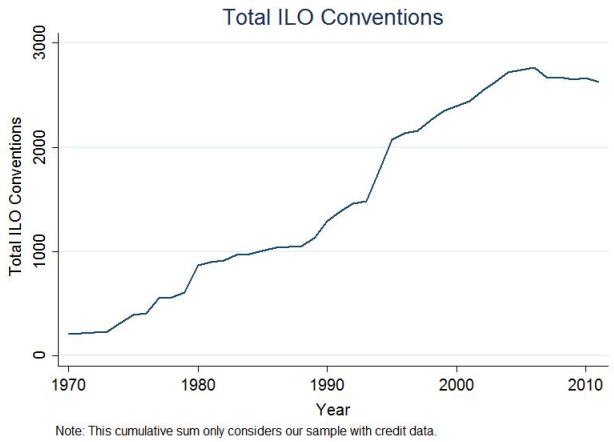


Figure 2.1: ILO's conventions ratifications

Source: ILO website, compilation by the authors.

The International Labour Organisation and waves of ratifications The International Labour Organisation (ILO) was created in 1919, as part of the Treaty of Versailles that ended World War I, *"to reflect the belief that universal and lasting peace can be accomplished only if it based on social justice"* (ILO Website).[19] The ILO has 187 member States, is the oldest UN agency and is characterized by its tripartite structure: each State is represented by its government, by workers' representatives and by employers' representatives. They set international labour standards by adopting conventions and recommendations. The ratification of conventions is voluntary. Once one country has ratified a convention, it becomes binding. Ratifying countries commit themselves to applying the Convention in national law and practice and to reporting on its application at regular intervals. Today, there are 189 conventions covering all fields related to labour relations (collective bargaining, forced labour, child labour, equality of opportunity and treatment, labour administration and inspection, employment policy, vocational guidance and training, job security, wages, working time, occupational safety and health, social security, maternity protections...). Ar-

[19] http://www.ilo.org/global/about-the-ilo/history/lang--en/index.htm

eas covered by these conventions are therefore much broader than labour market institutions.

ILO strategy has evolved over time (see Rodgers et al., 2009 for a global overview of ILO history). The launching of the World Employment Programme in 1969 "*marked the formal beginning of an ILO concern with problems of poverty reduction in developing countries*" (Rodgers et al., 2009, p. 186). Then, under the leadership of the Director-General Francis Blanchard (1973 - 1989), the ILO expands significantly technical cooperation programs (such as the PIACT, the French acronym for the International Programme for the Improvement of Working Conditions and Environment, launched in 1975) in order to assist countries in the implementation of international labour standards. Regional employment teams were established in Africa, Latin America and the Caribbean, and Asia during the 1970s. This led to a substantial increase in ILO ratifications, particularly in developing countries. Clearly, these ratifications became possible because of the ILO policy and were not related to policy changes within countries.

The ILO model of tripartite dialogue was contested in the eighties with the increasing influence of free-market economics in international economic policies. But the fall of the Eastern European socialist regimes and the disintegration of the Soviet Union created new demands for the ILO, notably to strengthen independent workers' and employers' organizations in the countries concerned. And a debate started in the middle of the nineties around the social costs of globalization and the Washington consensus. This created a new political space for ILO actions. The 1995 Social Summit of Copenhagen and the 1998 Declaration on Fundamental Principles and Rights at Work gave a new focus on Human Rights at Work with the recognition of the core labour standards (freedom of association and collective bargaining, elimination of forced labour and child labour, and eradication of discrimination at work). This led to a new dynamic of ratifications, once again more related to global trends than specific national contexts. Once more, technical cooperation programs played a role, with the implementation of the International Program on the Elimination of Child Labour (IPEC), starting in 1992, targeting more than 90 countries. Part of the impulsion came from additional funding from a growing number of donors countries (Rodgers et al., 2009, p. 73).

A careful look to the evolution of through the ILO ratifications over time is consistent with

the two different waves we identified analyzing the history of ILO. In average over the period, there are 30 additional conventions that are ratified per year. But we observe some peaks. In 1971 (corresponding to the beginning of the first wave), we observed 62 additional conventions, the number of ratifications between 1977 and 1981 (end of the first wave) is above average (from 36 in 1977 to 51 in 1981). The second wave is starting in the mid-90s and we observe two peaks in 1999 and 2000 (with respectively 49 and 44 ratifications), right after the adoption of the Declaration on Fundamental Principles and Rights at Work. This is consistent with our hypothesis it is possible to identify dynamics of ratifications that are depending on international policies and strategies of the ILO, and not to national circumstances. We believe it is a strong argument supporting the orthogonality condition of our instrument.

ILO ratifications and credit market liberalisation One particular threat to identification is that ILO conventions might be correlated with other variables that should also have an impact on inequalities. If governments aiming at strengthening labour regulations are also ratifying ILO conventions, our instrument would be correlated with broader labour market regulations. It would be a matter of concern if labour market *deregulation* and financial deregulation are correlated, as the latter is likely to have a direct effect on our dependent variable: household credit. It is the main argument of Tridico (2012) who shows that these two policies are often part of the same policy package of deregulation. It is why we do not use indexes of labour market regulations as instrument. We therefore test how instrument (ILO ratification) and credit market liberalisation evolve.

We find that the evolution of ILO ratifications is poorly correlated with the evolution of both labour market regulation and credit market regulation. The correlation between the evolution of ILO ratification and the evolution of credit market deregulation is only 0.08, and between the evolution of ILO ratification and the evolution of labour market deregulation only 0.04. We also calculate what is the average change in the credit market deregulation index, when there is no change in the number of ILO ratifications, when there is one additional ILO ratified conventions, and when there is more than one ILO ratified conventions. We do not observe significant differences between the average evolution of the index of credit market deregulation, depending on the number

of additional ILO conventions ratified.[20] We also test the opposite relation: the average change of ILO conventions when there is respectively more credit market regulation, no change, or less credit market regulation. The average change of ILO conventions is not statistically different depending on the change of credit market regulation.

Beyond this analysis of correlation, we identified two main waves of ratifications: mid-70s to beginning of 80s and end of the 90s. It does not correspond to massive waves of liberalisation that occured mainly in the 80s and beginning / mid-90s. It is an additional argument showing that these waves of ratifications are uncorrelated with dynamics of liberalization. We therefore conclude that the change in inequalities explained by our instrument is not likely to be driven by other policy changes that would violate the exclusion restriction.

For all these reasons, we argue that some dynamics in ILO conventions ratifications are explained by global policies and strategies, exogenous to countries' characteristics, and consequently should not violate the exclusion restriction in our IV strategy.

ILO conventions and inequalities On the other side, the ratification of ILOs conventions is likely to have an effect on inequalities, ensuring the strength of our instrument. This assumption is confirmed by Calderón and Chong (2009) in a cross-country study on the effect of labour regulations on inequality. They find a negative and statistically significant link between labour regulation measures and the distribution of income and argue that *"there appears to be an impact on the distribution of income as a result of a country having accumulated an increasing number of International Labour Organization conventions ratified by a country over time"* (Calderón and Chong, 2009, p.75). This negative link between labour market institutions and inequalities has been confirmed by Checchi and García-Peñalosa (2008) on a panel of OECD countries over the 1969-2004 period, even when taking into account the potential adverse effect in terms of unemployment.[21]

Therefore, we are going to use as instrumental variable the number of ILO conventions ratified, which is both time and country-varying. Our main econometric strategy estimates the effect of

[20] The average change in credit market deregulation index is respectively 0.05, 0.06 and 0.09 when there is no change, one addition ILO convention and more than one addition ILO conventions. The confidence interval for each mean are crossing each other.

[21] In this paper, they focus on a narrower definition of labour market institutions: union density, unemployment benefit, employment protection, wage coordination, tax wedge and minimum wage.

exogenous changes in inequality (through variations in this number of ILO conventions ratified) on the ratio of household credit to GDP

$$Ineq_{i,t} = \alpha ILO_{i,t} + \delta X_{i,t} + \lambda_i + \lambda_t + \mu_{i,t} \tag{2.23}$$

$$Credit_{i,t} = \beta \widehat{Ineq}_{i,t} + \Gamma X_{i,t} + \lambda_i + \lambda_t + \epsilon_{i,t} \tag{2.24}$$

where $\widehat{Ineq}_{i,t}$ is the predicted value of the inequality index from Equation 2.23. Given that they give higher protection and bargaining power to workers, we expect a negative association between this variable and inequality. This is what confirms Table 2.3: Inequality decreases when the number of ILO conventions ratified increases. Put differently a higher number of signed ILO conventions decreases the Gini index and the share of Top incomes, and increases the shares of bottom and middle incomes. This result also holds when we include instead lagged values of the number of ILO conventions(see Table 2.18). In Supplementary Material 2.7.3, we also provide evidence that $ILO_{i,t}$ is not likely to violate exclusion restrictions seriously. Table 2.19 reports estimates of a modified Equation 2.22, including the number of ILO conventions ratified $ILO_{i,t}$. Results largely support that the exclusion restrictions are respected, whatever the indicator of inequality used or the considered countries (developed or emerging): the number of ILO conventions appears consistently insignifcant in most cases, or very weakly significant in a couple of specifications.

Table 2.3: First stage inequality structure

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dep. Var.	Gini	Top 10	Top30	Middle 30 90	Middle 30 70	Bottom	$\frac{Top10}{Mid.30-90}$	$\frac{Top10}{Bottom}$	$\frac{Top30}{Mid.30-70}$	$\frac{Top30}{Bottom}$
# ILO Conv.	-0.321***	-0.232***	-0.255***	0.143*	0.193***	0.373***	-0.210***	-0.271***	-0.230***	-0.294***
	(0.0654)	(0.0687)	(0.0642)	(0.0847)	(0.0679)	(0.0720)	(0.0662)	(0.0598)	(0.0582)	(0.0597)
GDP per capita	- 0.0292	-0.107	-0.0845	0.228**	0.191**	-0.0583	-0.124	-0.101	-0.132*	-0.0791
	(0.0733)	(0.0807)	(0.0767)	(0.104)	(0.0913)	(0.0728)	(0.0761)	(0.0671)	(0.0707)	(0.0682)
Broad Money Ratio	0.133***	0.119***	0.121***	-0.0823***	-0.0906***	-0.156***	0.0967***	0.0564**	0.0687***	0.0612***
	(0.0244)	(0.0246)	(0.0236)	(0.0274)	(0.0242)	(0.0257)	(0.0233)	(0.0223)	(0.0218)	(0.0226)
Credit Dereg.	0.0967***	0.0780***	0.0950***	-0.0368	-0.0698***	-0.126***	0.0584***	0.0691***	0.0632***	0.0819***
	(0.0214)	(0.0221)	(0.0212)	(0.0278)	(0.0231)	(0.0243)	(0.0217)	(0.0204)	(0.0202)	(0.0207)
Obs.	896	896	896	896	896	896	896	896	896	896
Countries	41	41	41	41	41	41	41	41	41	41
adj. R^2	0.173	0.104	0.130	0.024	0.055	0.196	0.033	0.008	-0.003	0.023

All variables are standardized, except the log(real GDP per capita). Robust standard errors in parentheses. Country and Year Fixed Effects.
*, ** and *** denote respectively significance at the 1, 5 and 10% levels.

Finally, we performed the Durbin–Wu–Hausman test for exogeneity of regressors ("Durbin-

Wu" statistics, together with p-values, are reported at the bottom of each Table). Unsurprisingly, the null hypothesis of exogeneity is rejected in most cases, which confirms the need to use IV methodologies. In all estimations, we will also report the F-stat form of the Kleibergen-Paap statistic ("KFP" at the bottom of each Table)), the heteroskedastic and clustering robust version of the Cragg-Donald statistic suggested by Stock and Yogo (2005) as a test for weak instruments. Most statistics are comfortably above the critical values, confirming that our instrument is a strong predictor of inequality.

2.5 Results

2.5.1 Baseline Results

We present in Table 2.4 our baseline results for equation 2.24, in which various indicators of income distribution are instrumented by the number of ILO conventions ratified at the country-level. In order to ease comparisons, reported estimates are standardized coefficients, i.e. they are based on variables rescaled so as to have zero mean and a variance equal to one. Column (1) relies on the Gini, which gives an idea of the "average" inequality of the income distribution. Columns (2) to (6) go into more details of the structure of inequality, first by focusing on top incomes (Top 10 in column (2) and Top 30 in column (3)), then on middle incomes (either incomes from the 3^{rd} to the 9^{th} decile in column (4), or those from the 3^{rd} to the 7^{th} decile in column (5)) and low incomes (up to the 3^{rd} decile, in column (6)). Columns (7) to (10) go one step further by studying the impact of relative variations of these different shares, through ratios between top incomes and middle and lower incomes.

The first prediction of the theory is validated: positive changes in inequality, as predicted by changes in the number of ILO conventions ratified, are positively related with the ratio of household credit to GDP. This result holds whatever the inequality indicator used, even if the size of the effect varies significantly along the distribution of income (see below). In all cases, the strength of our instruments is confirmed by the Kleibergen-Paap statistics. Given the first stage coefficients (Table 2.3, column (1)), the ratification of one additional ILO convention is found to generate a -0.0017 decrease in the Gini (on a [0-1] scale), which in turn implies a 0.6 percentage point decrease in credit over GDP.

Table 2.4: Baseline

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dep. Var.	Household Credit/GDP									
Gini	1.288***									
	(0.333)									
Top 10		1.779***								
		(0.577)								
Top 30			1.621***							
			(0.481)							
Middle 30 90				-2.882*						
				(1.672)						
Middle 30 70					-2.141***					
					(0.802)					
Bottom 0 30						-1.109***				
						(0.286)				
Top 10/Middle 30 90							1.967***			
							(0.650)			
Top 10/Bottom								1.525***		
								(0.369)		
Top 30/Middle 30 70									1.793***	
									(0.498)	
Top 30/Bottom										1.408***
										(0.330)
GDP per capita	0.0653	0.218	0.165	0.684	0.436	-0.0370	0.272	0.182	0.264	0.139
	(0.126)	(0.185)	(0.161)	(0.526)	(0.285)	(0.111)	(0.192)	(0.123)	(0.164)	(0.116)
Broad Money Ratio	0.0340	-0.00673	0.00930	-0.0321	0.0111	0.0324	0.0149	0.119**	0.0820	0.119**
	(0.0693)	(0.0954)	(0.0839)	(0.179)	(0.106)	(0.0686)	(0.0930)	(0.0574)	(0.0682)	(0.0563)
Credit Deregulation	-0.164***	-0.179***	-0.194***	-0.146	-0.189**	-0.179***	-0.155**	-0.145***	-0.153***	-0.155***
	(0.0506)	(0.0634)	(0.0618)	(0.0992)	(0.0774)	(0.0524)	(0.0606)	(0.0506)	(0.0554)	(0.0506)
$DurbinWu-stat$	27.871	26.793	27.603	27.919	26.649	31.681	26.998	24.932	26.620	24.733
$P-value$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$KPF-stat$	24.089	11.440	15.775	2.867	8.083	26.802	10.08	20.579	15.705	24.209
Obs.	896	896	896	896	896	896	896	896	896	896
Countries	41	41	41	41	41	41	41	41	41	41
adj. R^2	0.438	0.211	0.331	-1.117	0.040	0.440	0.068	0.362	0.217	0.417

All variables are standardized, except the log(real GDP per capita). Robust standard errors in parentheses. Country and Year Fixed Effects.
The critical value for the weak instruments test is based on a 10% 2SLS bias at the 5% significance level, which is 16.4 in all estimations.
*, ** and *** denote respectively significance at the 1, 5 and 10% levels.

Regarding control variables, GDP per capita and M2 over GDP have the expected positive signs, but are mostly insignificant - additional investigation to come afterwards actually show that these averages insignificant effect hide some heterogeneity between developed and emerging countries. Conversely, financial deregulation exhibits a negative impact on credit, which seems at first sight at odd with the intuition that financial liberalization supports credit expansion. However, remember that we use the ratio of credit over GDP as a dependent variable: in other words, the negative sign simply means that there is a stronger correlation between financial liberalization and GDP than between financial liberalization and credit. This is confirmed by the results displayed in Table 2.10, where the financial liberalization indicator shows the expected positive impact on the log of household credit.

Going into more details, a one standard deviation in the Gini index is associated with a 6.9 percentage point increase in the household credit to GDP ratio. Interestingly, when we investigate specific parts of the income distribution, effects display some quantitative heterogeneity: when inequality is measured through the top incomes share, an increase by one standard deviation lifts credit to GDP ratio by 10.3 (Top 10) and 8.5% (Top 30). Besides, as indicated by the second prediction of our model, this effect is substantially higher when the share of middle incomes is concerned: for instance, when the share of Middle 30-70 in total income increases by one standard deviation (meaning a *decrease* in the inequality of the distribution of income), credit to GDP decreases by 11.5% percentage points, whereas the same one standard deviation increase in low-income share only cuts credit to GDP ratio by 6.2 percentage points. Similar effect can be found with income shares ratios: credit over GDP raises by 10% following a one standard deviation increase in the ratio of Top 30 over Middle 30-70, and by 7.7% following same increase for the ratio of Top 30 over Bottom. Note that these differences are significant: systematic chi-2 tests for equality of coefficients have been performed, and they all reject at the 1% level that the coefficient for Bottom0-30 is equal either to Middle 30-70 or to Middle 30-90 and that coefficients for top incomes over middle incomes are equal to those top incomes over bottom incomes. This is consistent with the fact that middle-classes weigh significantly more on aggregate credit, due to higher solvency and borrowing capacities. This would suggest that expansion of household credit over the considered period is the consequence of deteriorating standards of living, at least in relative terms.

2.5.2 Advanced versus Emerging Economies

The third and last implication of our theoretical approach predicts that the positive causal link from inequality to household credit exists if and only if the country is sufficiently developed. In a few words, the underlying intuitions are the following: on the supply side, the financial system is on average less developed in emerging countries, meaning more binding credit constraints and less credit available. On the demand side, it is also plausible than the mechanism relative to the relative income hypothesis and mimetic consumption is less at play in economies where the middle-class is not developed as it is in the advanced countries; it is important since a key result of this paper is the quantitative importance of the share of middle incomes to explain the aggregate dynamics of credit. Since our sample includes a majority of developed countries, but also a significant number of emerging countries, we can bring this intuition to the data by estimating again our empirical model on two subsamples: the first one is restricted to developed countries (estimates reported in Table 2.5), and the second one, to emerging economies (results in Table 2.6).

As expected, our results, both about the impact of inequality and its structure, hold strongly for developed economies, where middle-classes have access to credit and are important enough to drive the dynamics of aggregated household credit. Conversely, no such effect can be observed for emerging economies, possibly due to credit constraints (as suggested by Kumhof et al., 2012) and too small middle-classes (see Kochhar, 2015). This is all the more striking that all inequality measures deliver the same message. Interestingly, credit deregulation does not seem to have any impact on either subsample, and GDP per capita emerges as a significant determinant only for developing economies. This would tend to suggest that at early stage of economic development, credit constraints ar so binding that only an increase in average wealth per capita can ease access to credit; after a certain threshold of development however, credit constraints become less binding (as suggested by the insignifcant coefficient on GDP per capita), and the inequality mechanism driving up household credit (over GDP) suggested by our theoretical framework starts working.

Finally, we investigate further the role of credit constraints in emerging economies, by examining the heterogenous response of household credit to inequality according to the openness of to international financial flows. Here we use the Chinn and Ito index measuring a country's degree of capital account openness. Table 2.7 shows how the casual relationship between household credit

Table 2.5: Baseline with only advanced economies

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dep. Var.	Household Credit/GDP									
Gini	1.216***									
	(0.445)									
Top 10		1.422***								
		(0.524)								
Top 30			1.323***							
			(0.488)							
Middle 30 90				-1.630***						
				(0.625)						
Middle 30 70					-1.364***					
					(0.479)					
Bottom 0 30						-1.040***				
						(0.385)				
Top 10/Middle 30 90							1.698***			
							(0.603)			
Top 10/Bottom								1.893***		
								(0.579)		
Top 30/Middle 30 70									1.755***	
									(0.580)	
Top 30/Bottom										1.762***
										(0.548)
GDP per capita	-0.148	-0.238	-0.149	-0.402	-0.215	-0.0972	-0.267	-0.159	-0.179	-0.126
	(0.286)	(0.293)	(0.295)	(0.323)	(0.286)	(0.296)	(0.287)	(0.258)	(0.275)	(0.265)
Broad Money Ratio	0.187**	0.211***	0.198**	0.309***	0.267***	0.160*	0.230***	0.237***	0.242***	0.224***
	(0.0816)	(0.0749)	(0.0780)	(0.0525)	(0.0564)	(0.0917)	(0.0683)	(0.0626)	(0.0616)	(0.0669)
Credit Deregulation	-0.0701	-0.0208	-0.0555	0.0893	0.00809	-0.112*	-0.00429	-0.0322	-0.0225	-0.0510
	(0.0513)	(0.0498)	(0.0519)	(0.0662)	(0.0515)	(0.0574)	(0.0492)	(0.0456)	(0.0483)	(0.0476)
$DurbinWu-stat$	18.813	15.726	18.805	12.401	14.244	22.432	14.627	18.135	16.242	20.737
$P-value$	0.000	0.0001	0.000	0.0004	0.0002	0.000	0.0001	0.000	0.0001	0.000
$KPF-stat$	18.90	16.693	18.800	11.130	20.593	18.839	18.576	44.738	30.133	43.625
Obs.	611	611	611	611	611	611	611	611	611	611
Countries	25	25	25	25	25	25	25	25	25	25
adj. R^2	0.599	0.581	0.600	0.500	0.621	0.574	0.595	0.665	0.650	0.656

All variables are standardized, except the log(real GDP per capita). Robust standard errors in parentheses. Country and Year Fixed Effects.
The critical value for the weak instruments test is based on a 10% 2SLS bias at the 5% significance level, which is 16.4 in all estimations.
*, ** and *** denote respectively significance at the 1, 5 and 10% levels.

Table 2.6: Baseline with only emerging economies

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dep. Var.	Household Credit/GDP									
Gini	-0.280									
	(0.183)									
Top 10		-0.376								
		(0.256)								
Top 30			-0.384							
			(0.251)							
Middle 30 90				0.344						
				(0.252)						
Middle 30 70					0.344					
					(0.227)					
Bottom 0 30						0.458				
						(0.313)				
Top 10/Middle 30 90							-0.386			
							(0.292)			
Top 10/Bottom								-0.346		
								(0.288)		
Top 30/Middle 30 70									-0.325	
									(0.237)	
Top 30/Bottom										-0.342
										(0.280)
GDP per capita	0.716***	0.799***	0.773***	0.824***	0.784***	0.739***	0.804***	0.725***	0.737***	0.706***
	(0.104)	(0.161)	(0.138)	(0.191)	(0.145)	(0.126)	(0.180)	(0.133)	(0.126)	(0.117)
Broad Money Ratio	0.144***	0.161***	0.141***	0.167***	0.136***	0.150***	0.168***	0.129***	0.135***	0.122***
	(0.0339)	(0.0439)	(0.0372)	(0.0474)	(0.0362)	(0.0421)	(0.0497)	(0.0368)	(0.0373)	(0.0362)
Credit Deregulation	-0.0249	-0.0181	0.00413	-0.0598	-0.0248	0.0521	-0.0396	-0.0200	-0.0402	-0.00530
	(0.0547)	(0.0618)	(0.0713)	(0.0447)	(0.0571)	(0.102)	(0.0563)	(0.0759)	(0.0540)	(0.0848)
$KPF - stat$	10.977	5.623	5.48	5.415	7.208	3.187	4.172	2.963	4.956	2.923
Obs.	285	285	285	285	285	285	285	285	285	285
Countries	16	16	16	16	16	16	16	16	16	16
adj. R^2	0.802	0.735	0.756	0.695	0.754	0.741	0.643	0.636	0.678	0.661

All variables are standardized, except the log(real GDP per capita). Robust standard errors in parentheses. Country and Year Fixed Effects.
The critical value for the weak instruments test is based on a 10% 2SLS bias at the 5% significance level, which is 16.4 in all estimations.
*, ** and *** denote respectively significance at the 1, 5 and 10% levels.

over GDP (columns (2) and (3)) and the log of real household credit is altered around a threshold of 0.65 for the index, above which countries have a capital account considered as fully open. Interestingly, they show that emerging countries displaying a sufficient level of openness to international capital flows (columns (2) and (5)) do exhibit a positive impact of inequality on household credit. Conversely, there is not any impact of the Gini index on credit for countries with a low or limited level of openness (i.e. below this threshold, see columns (3) and (6)). This goes again in the direction of a relaxation of credit constraints by incoming financial flows, allowing wider categories of population to access credit, and consequently, to react to variations in inequality.

Table 2.7: Level of financial openness of emerging economies

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	Household Credit/GDP			log(Real Household Credit)		
Kaopen		>0.65	<0.65		>0.65	<0.65
Gini	-0.283	0.373*	0.319	-3.729***	0.680**	-9.854*
	(0.178)	(0.222)	(2.441)	(1.247)	(0.305)	(5.436)
GDP per capita	0.706***	-0.0791	-0.0164	4.821***	0.0164	6.340*
	(0.123)	(0.475)	(1.778)	(0.974)	(0.771)	(3.340)
Broad Money Ratio	0.134***	-0.173**	0.247			
	(0.0426)	(0.0679)	(0.570)			
Log(Real Broad Money)				1.069**	-0.614***	5.965**
				(0.520)	(0.213)	(2.571)
$KPF - stat$	10.821	5.329	0.136	14.298	5.820	3.323
Obs.	285	68	214	285	68	214
Countries	16	6	10	16	6	10
adj. R^2	0.801	-0.017	0.850	0.108	0.666	-1.144

All variables are standardized, except the log(real GDP per capita). Robust standard errors in parentheses. Country and Year Fixed Effects. The critical value for the weak instruments test is based on a 10% 2SLS bias at the 5% significance level, which is 16.4 in all estimations.
*, ** and *** denote respectively significance at the 1, 5 and 10% levels.

2.5.3 Robustness and Falsification Tests

Definition of Middle Classes. A key result reported above is the quantitative prevalence of middle classes in the positive causal impact of inequalities on household credit over/GDP. However, it could be argued that this is due mainly to the two specific definitions of middle classes we use, i. e., the share of income held by incomes after the 3$^{\text{rd}}$ and up to the 9$^{\text{th}}$ decile, or the share held by incomes after the 3$^{\text{rd}}$ and up to the 7$^{\text{th}}$.

Therefore, Table 2.8 reports the results of estimates testing the validity of this definition, based

on two strategies. First, columns (1) and (4) substitute to our preferred definitions of middle classes on the right-hand side two alternatives : the share of income owned by the 3rd to the 8th decile (the definition proposed by Easterly, 2001) in column (1), and the share of income owned by the 4th to the 7th decile in column (4). While slightly lower, corresponding standardized coefficients are still around twice higher than the one found for low incomes in Table 2.4. Second, columns (3) and (6) report estimates that, on the contrary, have to be understood more as falsification tests, to the extent the variables they are based on mix explicitly low (2nd and 3rd decile) and middle incomes. As expected, the estimated coefficients (still negative and significant) are getting closer to the one reported in column (6) in Table 2.4. Finally, columns (2) and (5) display estimates which are compromises between these two strategies, by putting the lower bound on the 2nd decile. Also as expected, elasticities remain negative and significant, somewhat higher than the one found on low incomes, but still lower than when the estimation restricts to consistent definitions of middle incomes. All in all, Table 2.8 does confirm the importance of middle classes in the positive dynamics linking inequality to credit.

Impact of the Great Recession. One may argue that our results may be influenced by the Great Recession, which has been notably characterized by an abrupt credit crunch. Table 2.9 replicates estimates from Table 2.4 but excluding all years after 2007. Reported results are basically identical to those presented in Table 2.4, indicating that no impact of the Great recession on our key mechanism can be detected.

Dependent Variable. We provided several arguments in the data section advocating the ratio of household credit over GDP as a dependent variable. To sum it up, our focus in on the part of the rise in credit which is not matched by a corresponding increase in output. Still, it can be interesting to see what happens when we substitute the log of household credit to its ratio over GDP as a dependent variable in equation 2.24. The results of this modification are reported in Table 2.10 and 2.11, which replicates the structure of Table 2.4, respectively for developed and emerging countries. Regarding developed countries, it is striking to see that our first prediction still holds: estimates keep supporting a positive impact of inequality on the log of household credit, whatever the variable used to proxy inequality. However, there does not seem to be any difference

Table 2.8: Baseline with various definitions of middle-class

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	Household Credit/GDP					
Middle 30 80	-2.461**					
	(1.074)					
Middle 20 80		-2.070***				
		(0.763)				
Middle 10 80			-1.783***			
			(0.572)			
Middle 40 70				-2.333**		
				(0.945)		
Middle 20 70					-1.868***	
					(0.625)	
Middle 10 70						-1.646***
						(0.496)
GDP per capita	0.535	0.390	0.244	0.418	0.326	0.200
	(0.360)	(0.263)	(0.195)	(0.301)	(0.226)	(0.175)
Broad Money Ratio	-0.0193	0.00120	0.0243	0.0237	0.0216	0.0388
	(0.133)	(0.107)	(0.0866)	(0.108)	(0.0918)	(0.0784)
Credit Deregulation	-0.184**	-0.188**	-0.185***	-0.151**	-0.192***	-0.188***
	(0.0879)	(0.0753)	(0.0652)	(0.0752)	(0.0695)	(0.0621)
$DurbinWu-stat$	27.284	26.962	26.625	26.788	26.726	26.646
$P-value$	0.000	0.000	0.000	0.000	0.000	0.000
$KPF-stat$	5.508	8.369	12.174	6.594	10.996	14.895
Obs.	896	896	896	896	896	896
Countries	41	41	41	41	41	41
adj. R^2	-0.281	0.055	0.246	-0.139	0.210	0.327

All variables are standardized, except the log(real GDP per capita). Robust standard errors in parentheses. Country and Year Fixed Effects. The critical value for the weak instruments test is based on a 10% 2SLS bias at the 5% significance level, which is 16.4 in all estimations.
*, ** and *** denote respectively significance at the 1, 5 and 10% levels.

Table 2.9: Baseline without the Great Recession (years after 2007 excluded)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dep. Var.	Household Credit/GDP									
Gini	1.302***									
	(0.356)									
Top 10		1.895***								
		(0.657)								
Top 30			1.621***							
			(0.492)							
Middle 30 90				-4.617						
				(4.117)						
Middle 30 70					-2.521**					
					(1.027)					
Bottom 0 30						-1.045***				
						(0.280)				
Top 10/Middle 30 90							2.307***			
							(0.858)			
Top 10/Bottom								1.843***		
								(0.453)		
Top 30/Middle 30 70									2.170***	
									(0.638)	
Top 30/Bottom										1.645***
										(0.391)
GDP per capita	0.525***	0.912***	0.740***	2.911	1.521***	0.273**	1.010***	0.535***	0.899***	0.439***
	(0.158)	(0.272)	(0.213)	(2.291)	(0.545)	(0.139)	(0.302)	(0.148)	(0.228)	(0.146)
Broad Money Ratio	0.0459	0.0293	0.0324	0.0546	0.0511	0.0453	0.0422	0.178***	0.105	0.173***
	(0.0798)	(0.103)	(0.0893)	(0.248)	(0.115)	(0.0789)	(0.112)	(0.0653)	(0.0816)	(0.0632)
Credit Deregulation	-0.225***	-0.280***	-0.282***	-0.458	-0.381***	-0.215***	-0.273***	-0.218***	-0.279***	-0.221***
	(0.0634)	(0.0917)	(0.0830)	(0.370)	(0.146)	(0.0611)	(0.0947)	(0.0592)	(0.0803)	(0.0586)
$DurbinWu-stat$	31.805	29.334	30.036	32.077	28.499	38.519	30.230	28.063	29.365	28.004
$P-value$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$KPF-stat$	21.362	9.840	15.354	1.169	6.626	25.204	7.776	20.882	13.857	25.190
Obs.	666	666	666	666	666	666	666	666	666	666
Countries	39	39	39	39	39	39	39	39	39	39
adj. R^2	0.319	-0.037	0.220	-5.490	-0.357	0.337	-0.445	0.170	-0.118	0.290

All variables are standardized, except the log(real GDP per capita). Robust standard errors in parentheses. Country and Year Fixed Effects.
The critical value for the weak instruments test is based on a 10% 2SLS bias at the 5% significance level, which is 16.4 in all estimations.
*, ** and *** denote respectively significance at the 1, 5 and 10% levels.

between middle classes and bottom incomes anymore. Concerning emerging economies, the picture is less clear: our key result on the sportive relationship between inequality and credit seems to be reverted in roughly half specifications: an exogenous increase in inequality seems to raise the log of household credit; in the other half, results are weakly or not significant. However, the negative R^2 are clearly an invitation not to overinterpret these results: they indicate that with the log of household credit as a dependent variable, on average over the sample of emerging countries, our empirical model fits the data quite badly. Besides, column (5) in Table 2.7 presented previously suggested that above a sufficient threshold of openness to international capital flows, the positive impact of inequality on the log of household credit was restored also for emerging economies, in an estimated specification with correct statistical properties (high and positive R^2, sufficient predictive power of the instrumental variable).

Table 2.10: Log with only advanced economies

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dep. Var.	log(Real Household Credit)									
Gini	0.957**									
	(0.398)									
Top 10		1.081**								
		(0.443)								
Top 30			1.037**							
			(0.434)							
Middle 30 90				-1.155**						
				(0.450)						
Middle 30 70					-1.031***					
					(0.393)					
Bottom 0 30						-0.845**				
						(0.364)				
Top 10/Middle 30 90							1.283**			
							(0.503)			
Top 10/Bottom								1.505***		
								(0.526)		
Top 30/Middle 30 70									1.363***	
									(0.504)	
Top 30/Bottom										1.425***
										(0.511)
GDP per capita	2.519***	2.397***	2.504***	2.129***	2.345***	2.621***	2.349***	2.455***	2.419***	2.513***
	(0.337)	(0.321)	(0.341)	(0.301)	(0.311)	(0.363)	(0.311)	(0.308)	(0.315)	(0.320)
log(Real Broad Money)	-0.0641	-0.00994	-0.0486	0.147**	0.0614	-0.124	0.0167	-0.00764	0.0138	-0.0378
	(0.117)	(0.102)	(0.111)	(0.0710)	(0.0745)	(0.140)	(0.0925)	(0.0890)	(0.0843)	(0.0975)
Credit Deregulation	0.129**	0.170***	0.141***	0.251***	0.192***	0.0927	0.182***	0.158***	0.167***	0.142***
	(0.0529)	(0.0527)	(0.0533)	(0.0602)	(0.0519)	(0.0580)	(0.0522)	(0.0491)	(0.0503)	(0.0502)
$DurbinWu-stat$	30.066	24.882	30.609	15.458	21.996	33.553	22.892	30.318	27.933	32.689
$P-value$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$KPF-stat$	18.011	17.342	18.120	13.630	22.134	16.491	19.678	40.864	30.056	37.872
Obs.	611	611	611	611	611	611	611	611	611	611
Countries	25	25	25	25	25	25	25	25	25	25
adj. R^2	0.730	0.721	0.730	0.707	0.759	0.709	0.735	0.782	0.772	0.774

Inequality measures, OLI conventions and the index of credit deregulation are standardized. Robust standard errors in parentheses. Country and Year Fixed Effects. The critical value for the weak instruments test is based on a 10% 2SLS bias at the 5% significance level, which is 16.4 in all estimations. *, ** and *** denote respectively significance at the 1, 5 and 10% levels.

Table 2.11: Log with only emerging economies

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dep. Var.	log(Real Household Credit)									
Gini	-4.642***									
	(1.673)									
Top 10		-5.470**								
		(2.197)								
Top 30			-6.278**							
			(2.852)							
Middle 30 90				4.598***						
				(1.695)						
Middle 30 70					5.447**					
					(2.165)					
Bottom 0 30						7.850*				
						(4.652)				
Top 10/Middle 30 90							-5.548**			
							(2.530)			
Top 10/Bottom								-6.583		
								(4.588)		
Top 30/Middle 30 70									-5.493**	
									(2.754)	
Top 30/Bottom										-6.850
										(5.017)
GDP per capita	5.146***	5.566***	5.908***	5.232***	5.687***	5.968**	5.610***	6.333**	5.513***	6.303**
	(1.126)	(1.444)	(1.724)	(1.242)	(1.415)	(2.339)	(1.667)	(2.901)	(1.698)	(3.017)
log (Real Broad Money)	0.170	0.947	0.327	1.493**	0.660	-0.215	0.973	-0.811	0.139	-1.163
	(0.620)	(0.721)	(0.803)	(0.685)	(0.714)	(1.055)	(0.793)	(1.444)	(0.853)	(1.673)
Credit Deregulation	1.505***	1.417**	1.921**	0.694*	1.328**	2.968*	1.116*	1.846	1.227*	2.221
	(0.569)	(0.609)	(0.899)	(0.366)	(0.592)	(1.726)	(0.591)	(1.366)	(0.711)	(1.682)
$KPF - stat$	11.880	7.699	6.29	8.323	8.842	3.218	5.603	2.299	4.997	2.079
Obs.	285	285	285	285	285	285	285	285	285	285
Countries	16	16	16	16	16	16	16	16	16	16
adj. R^2	-0.108	-0.681	-0.947	-0.630	-0.660	-1.800	-1.701	-3.761	-2.120	-3.796

Inequality measures, OLI conventions and the index of credit deregulation are standardized. Robust standard errors in parentheses. Country and Year Fixed Effects. The critical value for the weak instruments test is based on a 10% 2SLS bias at the 5% significance level, which is 16.4 in all estimations. *, ** and *** denote respectively significance at the 1, 5 and 10% levels.

Falsification tests. Most theoretical frameworks, including ours, predict that it should be only household credit that should be driven by inequality. A simple falsification test is therefore to check the impact on other credit aggregates, for which there should be no impact. A straightforward example is credit granted to private firms. On the other hand, what should be the impact of inequality on total credit is less clear, since it is the sum of both household and business credit.

Therefore, Table 2.12 reports estimates of equation 2.24 where the inequality indicator is the Gini (predicted by our IV), and the dependent variable is alternatively total credit from the World

Bank (column (1)), total credit form the BIS (column (2)), total bank credit form the BIS (column (3)), firm credit (column (4)) and household credit (column (5)) - all regressions from Table are rerun on a common sample to make sure that the sample alteration cannot be responsible for some differences. Columns (6) to (10) replicate columns (1) to (5) on a period excluding years after 2007, once again to premune against any influence from the Great Recession. As expected, inequality does not have any impact on firm credit (columns (4) and (9)), as well as on bank credit (columns (3) and (8)). Besides, columns (1)/(2) and (6)/(7) show that the way total credit is measured may be non-neutral on the result. When the measure by the World Bank is used, the impact of inequality remains positive (as in Perugini et al., 2016). When the measure by the BIS (the most legitimate for us since household and firm credit also come from the BIS) is used instead, the impact of the predicted Gini coefficient becomes insignificant on the whole period of estimation. A possible explanation comes from the fact that the World Bank aggregate excludes credit form the international financial sector, which may create a bias in the results. In any case, these "falsification evidence" points out that the positive causal impact of inequality is mainly concentrated on household credit.

Table 2.12: Falsification tests

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
			Whole Sample					Before 2008		
Dep. Var: Credit/GDP	TotalWB	TotalBIS	Bank	Firm	Household	TotalWB	TotalBIS	Bank	Firm	Household
Gini	3.384***	0.230	-0.517	-0.675	1.996***	3.872***	0.958**	0.540	0.231	2.377***
	(1.097)	(0.420)	(0.502)	(0.521)	(0.695)	(1.336)	(0.477)	(0.404)	(0.391)	(0.841)
GDP per capita	-0.246	-0.0378	0.238**	-0.215	0.151	0.376	0.572***	0.762***	0.269*	0.796***
	(0.244)	(0.111)	(0.112)	(0.134)	(0.177)	(0.363)	(0.171)	(0.164)	(0.154)	(0.256)
Broad Money Ratio	-0.127	0.198***	0.378***	0.257***	-0.0544	-0.246	0.102	0.264***	0.115	-0.109
	(0.187)	(0.0764)	(0.0924)	(0.0906)	(0.119)	(0.238)	(0.0953)	(0.0923)	(0.0800)	(0.150)
Credit Deregulation	-0.249**	0.0246	0.194**	0.178**	-0.238***	-0.489***	-0.0331	0.0230	0.160**	-0.364***
	(0.123)	(0.0625)	(0.0873)	(0.0776)	(0.0799)	(0.177)	(0.0724)	(0.0727)	(0.0695)	(0.116)
$DurbinWu-stat$	29.520	0.017	2.195	3.476	25.885	26.233	6.139	0.880	0.143	35.163
$P-value$	0.000	0.895	0.138	0.062	0.000	0.000	0.013	0.348	0.705	0.000
$KPF-stat$	9.913	9.913	9.913	9.913	9.913	8.723	8.723	8.723	8.723	8.723
Obs.	867	867	867	867	867	653	653	653	653	653
Countries	39	39	39	39	39	37	37	37	37	37
adj. R^2	-0.393	0.573	0.274	0.246	0.134	-0.732	0.447	0.324	0.376	-0.294

All variables are standardized, except the log(real GDP per capita). Robust standard errors in parentheses. Country and Year Fixed Effects.
The critical value for the weak instruments test is based on a 10% 2SLS bias at the 5% significance level, which is 16.4 in all estimations.
*, ** and *** denote respectively significance at the 1, 5 and 10% levels.

2.6 Conclusion

This paper extended the DSGE framework by Kumhof et al. (2015) to provide the intuition that both inequality and its structure should matter on credit dynamics. Based on a 41 countries dataset over the period 1970-2014, we confirm the first theoretical prediction of the model: using various indicators of inequality, we show that household credit is positively impacted by inequality when the latter is predicted by exogenous shocks on the number of ILO conventions ratified. A second prediction of our theoretical setting is that this positive impact should be stronger when inequality hits more middle classes (i.e. when their share of total income decreases, either in absolute or relative terms). This is once again confirmed by our empirical exercise. Those results are supported by various robustness and falsification tests, as well as alternative samples, which also show that our results hold mostly for developed countries, consistently with the third implication of the theoretical approach. For emerging economies, no such effects can be observed on average, possibly due to credit constraints and insufficiently important middle income categories. Consistently, it appears that the positive impact of inequality on household credit is restored on a sample of emerging countries with sufficient openness of the capital account: by relaxing financial constraints, capital inflows allow middle and low income agents to access credit more easily.

Our work has important implications regarding financial crises prevention. In order to avoid financial crises such as the one of 2007-2009, which triggered afterwards the Great Recession, one has therefore to prevent the creation of household leverage bubbles. Our findings suggest that the reduction of inequality is an important prerequisite of such a policy, especially at the middle of the income distribution.

2.7 Supplementary Material

2.7.1 Additional Proof and Discussions

Redistribution between middle-income and low-income households

We derive the effect of an increase in low- and middle classes' income share $\overline{z^i}$ on the steady-state debt level $\overline{b^j}$ for $i \in (L, M)$ and $i \neq j$,

$$\frac{\mathrm{d}log(\overline{b^i})}{\mathrm{d}log(\overline{z^j})} = \frac{\frac{\theta-1}{\theta}\frac{\gamma}{\overline{z^j}} + \frac{1}{\sigma}\frac{1}{\chi^j}\frac{\overline{y}}{\overline{c^j}}}{\frac{1-2\theta}{\theta}\frac{1}{\overline{b^i}} + \frac{1}{\eta}\frac{\frac{\chi^i}{\chi^T}}{1+\frac{\chi^i}{\chi^T}\overline{b^i}} - \frac{1}{\sigma}\frac{1}{\chi^i}\frac{1-\overline{p^i}}{\overline{c^i}} - \frac{1}{\sigma}\frac{\chi^i}{\chi^T}\frac{\overline{p^i}}{\overline{c^T}}(\varphi^i - \varphi^j)} \tag{2.25}$$

Following our assumption on the demand-side argument, this cross derivative exercise provides a positive impact of this redistribution in favor of the group j on the level of the debt chosen by the group j.

Proof of the 2^{nd} Testable Prediction

We determine if the bulk of the positive impact of inequality on household credit is driven by middle classes or by low-income classes. If middle classes is the key driver, so we should have

$$\frac{\mathrm{d}log(\overline{b^M})}{\mathrm{d}log(\overline{z^M})} < \frac{\mathrm{d}log(\overline{b^L})}{\mathrm{d}log(\overline{z^L})} < 0 \tag{2.26}$$

The proof is obtained by using the demand-side argument developed in equation (2.20) and by distinguishing the numerator and denominator of each part of the inequation (2.26).

About the *numerator*, we refer to our demand-side mechanism, that holds with $\theta > 1$. Because of higher consumption and income share for middle class than low-income households as defined in Table 2.13, the numerator holds this inequality

$$\frac{\theta-1}{\theta}\frac{\gamma}{\overline{z^M}} + \frac{1}{\sigma}\frac{1}{\chi^M}\frac{\overline{y}}{\overline{c^M}} < \frac{\theta-1}{\theta}\frac{\gamma}{\overline{z^L}} + \frac{1}{\sigma}\frac{1}{\chi^L}\frac{\overline{y}}{\overline{c^L}} \tag{2.27}$$

Table 2.13: Quantitative results - Baseline case

Symbol	Parameter	Value	Source
$\overline{y}$	Steady-State Output Level	1	
χ^T	Population Share of Top Income Households	0.10	Literature.
χ^M	Population Share of Middle Class Households	0.50	Literature.
χ^L	Population Share of Low-Income Class Households	0.40	Literature.
$\overline{z^T}$	Steady-State Top 10% Output Share	0.30	WIID
$\overline{z^M}$	Steady-State Middle Class Output Share	0.55	WIID
$\overline{z^L}$	Steady-State Low-Income Class Output Share	0.15	WIID

The steady-state output is normalized to one. The decomposition of bottom earners into low and middle-class incomes follow Palma (2011) and our empirical strategy. We use our inequality data from WIID in similar fashion to determine steady-state output shares for the three classes.

Given the inequation (2.27), the result obtained in inequation (2.26) crucially depends on their *denominators* and yields the following necessary condition

$$\frac{1-2\theta}{\theta}\frac{1}{\overline{b^M}}+\frac{1}{\eta}\frac{\frac{\chi^M}{\chi^T}}{1+\frac{\chi^M}{\chi^T}\overline{b^M}}-\frac{1}{\sigma}\frac{1}{\chi^M}\frac{1-\overline{p^M}}{\overline{c^M}}-\frac{1}{\sigma}\frac{\chi^M}{\chi^T}\frac{\overline{p^M}}{\overline{c^T}}(\varphi^M-\varphi^L)$$
$$<\frac{1-2\theta}{\theta}\frac{1}{\overline{b^L}}+\frac{1}{\eta}\frac{\frac{\chi^L}{\chi^T}}{1+\frac{\chi^L}{\chi^T}\overline{b^L}}-\frac{1}{\sigma}\frac{1}{\chi^L}\frac{1-\overline{p^L}}{\overline{c^L}}-\frac{1}{\sigma}\frac{\chi^L}{\chi^T}\frac{\overline{p^L}}{\overline{c^T}}(\varphi^L-\varphi^M) \quad (2.28)$$

This yields

$$\frac{1}{\overline{b^M}}\left[\frac{1-2\theta}{\theta}+\frac{1}{\eta}\frac{\frac{\chi^M}{\chi^T}}{1+\frac{\chi^M}{\chi^T}}\right]+\frac{1}{\sigma}\left[\frac{1-\overline{p^L}}{\chi^L\overline{c^L}}-\frac{1-\overline{p^M}}{\chi^M\overline{c^M}}\right]-(\varphi^M-\varphi^L)\frac{1}{\sigma}\frac{1}{\chi^T\overline{c^T}}\left[\overline{p^M}\chi^M-\overline{p^L}\chi^L\right]$$
$$<\frac{1}{\overline{b^L}}\left[\frac{1-2\theta}{\theta}+\frac{1}{\eta}\frac{\frac{\chi^L}{\chi^T}}{1+\frac{\chi^L}{\chi^T}}\right] \quad (2.29)$$

The first term in both sides of this inequation (2.29) clearly depends on the steady-state debt levels $\overline{b^M}$ and $\overline{b^L}$. With our assumption on the demand-side mechanism, the second testable prediction holds if the steady-state debt level to middle class $\overline{b^M}$ is sufficiently higher than those to low-income class $\overline{b^L}$.

The second term in the left-hand-side of this inequation (2.29) reflects the trade-off between price and quantity for both loans to middle-class and low-income households. Because of *financial exclusion* frontier in favor of French et al. (2013) and of segregation by Ouazad and Rancière (2016), we could easily assume that the market power of low-income household is lower than those of middle-class. Again, the smaller the amount p_t, the more expensive the implicit interest rate. So we anticipate that $\overline{p^M} \geq \overline{p^L}$. By definition of the three three groups of households, we have that $\chi^L \overline{c^L} < \chi^M \overline{c^M}$. Consequently, this second term is at odds with the inequation (2.29).

The latter term in the left-hand-side of this inequation (2.29) is subject to the top income household's preference on wealth and how they choose between credit to low- and middle-income households. We could imagine that top income households could prefer lending to middle-class. Following previous arguments, the term is the bracket is positive, so this third term plays in favor of the inequation (2.29).

It is clear from this inequation (2.29) that middle-class are the key driver of this positive impact of inequality on household credit if (i) the debt provided to middle-class is sufficiently higher than the debt provided to low-income households, (ii) there is some discrimination against the poorer ones and (iii) the pass-through to implicit interest rate of an inequality shock is not too high.

2.7.2 Data Sources

Table 2.14: Data sources

Variable	Description	Source
	Credit	
Household credit/GDP		BIS, CB, Oxford Economics
log(Household credit/price level)	GDP deflator from World Bank.	BIS, CB, Oxford Economics, WB
Firm credit/GDP	Linear intrapolation for some years for 5 countries.	BIS, CB, Oxford Economics
Domestic bank credit /GDP	Total non-financial credit from domestic bank.	BIS, WB, CB
Total domestic credit /GDP	Total non-financial credit from domestic financial system.	World Bank
Total credit/GDP	Total non-financial credit from domestic and international financial systems.	BIS
	Inequalities	
Gini		Wiid 3.4
Palma, deciles	Share in total income of the richest 10% with the one of the poorest 40%.	Wiid 3.4, Palma (2011)
	Control Variables	
GDP per capita	Log-linearized and relative to the price level.	World Bank
M2	Ratio divided by GDP or log-linearized and relative to the price level.	World Bank, CB
Credit Deregulation	Index from 0 to 10 about financial deregulation. Summary index.	Fraser Institute
	Instrument	
ILO conventions	International Labour Organization conventions ratifications.	ILO

Table 2.15: List of advanced economies: Time coverage and main sources

	Baseline Coverage	WIID Source	Household Cred.	Firm Cred.	Total BIS
Australia	1981-2010	LIS	BIS	BIS	BIS
Austria	1995-2014	Eurostat, European Comm.	BIS	BIS	BIS
Belgium	1995-2014	Eurostat, European Comm.	BIS	BIS	BIS
Canada	1981-2010	LIS	BIS	BIS	BIS
Czech Republic	1995-2013	LIS	BIS	BIS	BIS
Denmark	1994-2010	LIS	BIS	BIS	BIS
Estonia	2004-2014	Eurostat	CB	CB	
Finland	1970-2014	Eurostat, National Source	BIS	BIS	BIS
France	1980-2010	LIS	BIS	BIS	BIS
Germany	1978-2013	LIS	BIS	BIS	BIS
Greece	1995-2014	Eurostat	BIS	BIS	BIS
Hungary*	1991-2012	LIS	BIS	BIS	BIS
Iceland	2004-2014	Eurostat	CB	CB	
Ireland	2002-2014	Eurostat, European Comm.	BIS	BIS	BIS
Italy	1986-2010	LIS	BIS	BIS	BIS
Malta	2005-2014	Eurostat	CB	CB	
Netherlands	1990-2013	LIS	BIS	BIS	BIS
Norway	1979-2013	LIS	BIS	BIS	BIS
Poland	1995-2013	LIS	BIS	BIS	BIS
Portugal	1995-2014	Eurostat, European Comm.	BIS	BIS	BIS
Spain	1980-2013	LIS	BIS	BIS	BIS
Sweden	1981-2014	LIS, Eurostat	BIS	BIS	BIS
Switzerland	2007-2014	Eurostat	BIS	BIS	BIS
United Kingdom	1970-2014	IFS, Eurostat	BIS	BIS	BIS
United States	1979-2013	LIS	BIS	BIS	BIS

(*) meaning that divergent view according to UN and World Bank classifications. We follow UN classification.

Table 2.16: List of emerging economies: Time coverage and main sources

	Baseline Coverage	WIID Source	Household Cred.	Firm Cred.	Total BIS
Argentina	1994-2014	SEDLAC 2016	CB	BIS	BIS
Brazil	1994-2014	SEDLAC 2016	BIS	BIS	BIS
Chile*	1987-2013	SEDLAC 2016	CB	CB	
China	1992-2013	World Bank	OXFORD	BIS	BIS
Colombia	1996-2013	EDLAC	BIS	BIS	BIS
India	2004-2011	World Bank	OXFORD	BIS	BIS
Indonesia	2001-2014	World Bank	BIS	BIS	BIS
Israel*	1992-2012	LIS	BIS	BIS	BIS
Korea*	1970-2012	OECD, Other	BIS	BIS	BIS
Malaysia	2006-2009	World Bank	OXFORD	BIS	BIS
Mexico	1994-2014	SEDLAC 2016	BIS	BIS	BIS
Russian Fed.*	1998-2012	World Bank	BIS	BIS	BIS
Singapore*	2003-2012	National Source	BIS	BIS	BIS
South Africa	1994-2011	World Bank	OXFORD	BIS/OXFORD	BIS
Thailand	1991-2013	World Bank	BIS	BIS	BIS
Turkey	1987-2013	World Bank	BIS	BIS	BIS

(*) meaning that divergent view according to UN and World Bank classifications. We follow UN classification.

Table 2.17: Sources of inequality measures after processing WIID

Source	Countries
LIS	15
Eurostat	11
European Commission	2
OECD	1
World Bank	8
SEDLAC, EDLAC	5
National Sources, Other	4

2.7.3 Instrumental Variable, First Stage and Additional Tests

Table 2.18: First stage inequality structure, lagged variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Dep. Var.	Gini	Top 10	Top30	Middle 30 90	Middle 30 70	Bottom	$\frac{Top10}{Mid30-90}$	$\frac{Top10}{Bottom}$	$\frac{Top30}{Mid30-70}$	$\frac{Top30}{Bottom}$
# ILO Conv$_{t-1}$	-0.279***	-0.200***	-0.215***	0.124	0.159**	0.324***	-0.181***	-0.258***	-0.200***	-0.280***
	(0.0620)	(0.0664)	(0.0616)	(0.0831)	(0.0669)	(0.0669)	(0.0645)	(0.0588)	(0.0574)	(0.0585)
GDP per capita	-0.0574	-0.136*	-0.114	0.250**	0.217**	-0.0220	-0.139*	-0.0917	-0.139*	-0.0718
	(0.0757)	(0.0824)	(0.0786)	(0.106)	(0.0921)	(0.0779)	(0.0773)	(0.0673)	(0.0715)	(0.0692)
Broad Money Ratio	0.129***	0.120***	0.117***	-0.0929***	-0.0928***	-0.141***	0.102***	0.0640***	0.0729***	0.0655***
	(0.0247)	(0.0250)	(0.0240)	(0.0280)	(0.0248)	(0.0259)	(0.0240)	(0.0245)	(0.0229)	(0.0245)
Credit Dereg.	0.109***	0.0965***	0.111***	-0.0657**	-0.0951***	-0.135***	0.0741***	0.0720***	0.0755***	0.0840***
	(0.0207)	(0.0215)	(0.0204)	(0.0267)	(0.0219)	(0.0237)	(0.0211)	(0.0197)	(0.0195)	(0.0200)
Obs.	900	900	900	900	900	900	900	900	900	900
Countries	41	41	41	41	41	41	41	41	41	41
adj. R^2	0.186	0.117	0.142	0.033	0.067	0.203	0.041	0.014	0.002	0.029

All variables are standardized, except the log(real GDP per capita). Robust standard errors in parentheses. Country and Year Fixed Effects.
*, ** and *** denote respectively significance at the 1, 5 and 10% levels.

Table 2.19: Testing for exclusion restriction

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		Advanced economies					Emerging economies			
Inequality measure	Gini	$\frac{Top10}{Mid30-90}$	$\frac{Top10}{Bottom}$	$\frac{Top30}{Mid30-70}$	$\frac{Top30}{Bottom}$	Gini	$\frac{Top10}{Mid30-90}$	$\frac{Top10}{Bottom}$	$\frac{Top30}{Mid30-70}$	$\frac{Top30}{Bottom}$
Inequality	-0.207	-0.0609	-0.357	-0.189	-0.483	-0.00791	0.0157	0.0177	0.0155	0.0139
	(0.175)	(0.270)	(0.371)	(0.342)	(0.353)	(0.0705)	(0.0308)	(0.0334)	(0.0336)	(0.0386)
# ILO Conv.	-0.449*	-0.397	-0.456	-0.425	-0.489*	0.114	0.122	0.123	0.123	0.122
	(0.255)	(0.269)	(0.267)	(0.271)	(0.260)	(0.159)	(0.151)	(0.148)	(0.151)	(0.149)
GDP per capita	0.187	0.153	0.194	0.172	0.211	0.570***	0.556***	0.557***	0.558***	0.560***
	(0.582)	(0.591)	(0.578)	(0.590)	(0.575)	(0.106)	(0.0991)	(0.104)	(0.101)	(0.104)
Broad Money Ratio	0.340**	0.321**	0.333**	0.326**	0.344**	0.129	0.127	0.128	0.128	0.129
	(0.149)	(0.145)	(0.146)	(0.147)	(0.147)	(0.0863)	(0.0873)	(0.0895)	(0.0883)	(0.0898)
Credit Dereg.	-0.00395	-0.0139	-0.0101	-0.0126	-0.00334	-0.0895***	-0.0935***	-0.0950***	-0.0938***	-0.0948***
	(0.0891)	(0.0857)	(0.0886)	(0.0874)	(0.0897)	(0.0303)	(0.0304)	(0.0304)	(0.0302)	(0.0305)
Cons.	-2.525	-2.021	-2.630	-2.314	-2.886	-7.594***	-7.439***	-7.454***	-7.457***	-7.483***
	(6.072)	(6.226)	(6.024)	(6.207)	(5.960)	(1.240)	(1.188)	(1.251)	(1.210)	(1.252)
Obs.	611	611	611	611	611	285	285	285	285	285
Countries	25	25	25	25	25	16	16	16	16	16
adj. R^2	0.752	0.749	0.751	0.750	0.753	0.857	0.857	0.857	0.857	0.857

Dependent variable is Household Credit over GDP. All variables are standardized, except the log(real GDP per capita). Robust standard errors in parentheses. Country and Year Fixed Effects. *, ** and *** denote respectively significance at the 1, 5 and 10% levels.

Chapter 3

Trilemma, Dilemma and Global Players

This paper investigates the debate between the Mundellian trilemma and the dilemma. Overall, the global financial cycle magnifies the binding effect of financial openness on monetary policy autonomy, thus at the same time sharply reducing the effectiveness of the floating exchange rate regime to isolate the domestic economy against financial pressures. I provide empirical evidence that the trilemma does not morph into a dilemma. Furthermore, the sensitivity to the global financial cycle depends more on the presence of global investors and global banks than on the fluctuations of these financial forces.

3.1 Introduction

After the massive unconventional monetary policies of the Federal Reserve and the European Central Bank (ECB) in 2009, Dilma Roussef described them as a *monetary tsunami* and the Brazilian Finance Minister Guido Mantega spoke of a *currency war*. Large capital inflows could generate appreciation pressures, trigger credit booms, and fuel speculative asset bubbles, as suggested by Mendoza and Terrones (2008), among others. Conversely, the gradual withdrawal of the quantitative easing program announced by Ben Bernanke in the summer of 2013 has generally not simplified domestic monetary policy for policymakers. This *taper tantrum* has deepened financial vulnerabilities, leading to strong downward pressures on emerging currencies and increasing the likelihood

and the strength of further domestic financial crises. Therefore, the uncertainty about a new *taper tantrum* and Yellen's strategy point out the urgent need which policymakers in emerging markets have of efficient tools to isolate their domestic financial markets from US monetary policy. The spillover effects from the Fed are large, because it drives global liquidity and because of the high level of comovement in asset prices, credit, and risk aversion around the world. This worldwide trend is called the Global Financial Cycle by Rey (2015), and could potentially destabilize trilemma trade-offs.

The traditional trilemma in Mundell (1963) has long been considered as the key toolkit for international macroeconomists. According to this view, countries have to choose two out of three objectives, namely monetary policy independence, fixity of the exchange rate regime, and perfect capital mobility. By contrast, Rey (2015) supports that this trilemma has rather become a dilemma: countries must choose between monetary policy independence and financial openness, regardless of the exchange rate regime. The idea behind this new configuration is that financial flows are transmitted independently of the exchange rate regime. The resilience of domestic economies depends more on the ability of volatile and potentially destabilizing capital flows to get in or out of domestic financial systems rather than on the decision between a peg, a crawling band, or a managed floating rate. This controversy has important implications for policymakers regarding global capital flows and the prevention of financial vulnerabilities. If the trilemma remains valid, researchers should focus on the right configuration between the exchange rate regime and financial openness. But if the dilemma is true, the effectiveness of various capital flow management strategies, such as targeted capital controls and the macroprudential regulation toolkit, becomes the major challenge. Following Forbes et al. (2015), Klein (2012), and Klein and Shambaugh (2015), the design of capital controls and their complementarity with other policies are still puzzling.

This paper demonstrate that there is no move from trilemma to dilemma. It is in line with an extensive empirical literature based on Shambaugh (2004), Obstfeld et al. (2005), and Aizenman et al. (2008). Klein and Shambaugh (2015) update this approach by taking into account intermediate situations such as soft pegs or temporary and targeted capital controls. I follow their recent classifications of financial openness and exchange rate regime to get the finest possible level of classification. They find that managing the exchange rate regime allows greater monetary policy autonomy than a modest closure of capital account. This empirical result is close to Farhi and

Werning (2012) who model the interest of some capital controls for a small open economy with a fixed exchange rate to reintroduce the interest rate differential.

Concurrently, Rey (2015) and Passari and Rey (2015) try to support the dilemma in two steps. They prove the global financial cycle with the following sequence: US monetary policy drives the global risk aversion and uncertainty, proxied by the VIX, which in turn pushes international capital flows. These waves of flows are highly synchronized around the world and trigger financial domestic vulnerabilities in credit and asset markets.[1] They then show that these vulnerabilities do not seem to be influenced by exchange rate regimes. Yet, this is only conjectural evidence and their sample bias in favor of advanced economies may be another reason for their mitigated results. By contrast, this paper provides explicit proof because I directly use monetary policy independence as the dependent variable, and rigorous exchange rate classifications.[2] In the same spirit, Miranda-Agrippino and Rey (2015) and Rey (2016) draw attention to the global financial cycle and the international transmission channels of US monetary policy through VAR analyses. At least three mechanisms emerged from Rey (2016), namely the international credit channel, the risk-taking channel, and the "fear of floating" channel.[3]

The key contribution of this paper is to invalidate a gradual move from the trilemma to the dilemma: the increasing financial forces and linkages over time magnify the effects of financial openness but also of exchange rate management. The trilemma is worsened but does not disappear. My unbalanced sample covers 161 various countries characterized by a large variety of domestic monetary conditions from 1970 to 2013 which is sufficient to highlight trends and potential non-linearities. I take into account various national and global determinants of monetary policy independence and capture potential structural breaks. I test various assumptions to determine under which conditions there is a trilemma or dilemma. A rigorous interpretation of Rey

[1] Recent empirical papers on global *push* and national *pull* factors also support the idea of the dilemma. Forbes and Warnock (2012) and Ghosh et al. (2014) point out the role of global factors that drive capital flows, in particular the VIX. Ahmed and Zlate (2014) find that capital flows become more sensitive to the interest rate differential and to global risk aversion over time. In addition, this paper is not the first to investigate the non-linearities related to the VIX: Nier et al. (2014) demonstrate that the VIX becomes the main driver of capital flows when it is very high, but they never use thresholds.

[2] They use the coarse classification of Reinhart and Rogoff (2004), but their methodology compares official and dual markets. Therefore, their index gives a combination of both financial openness and exchange rate regime.

[3] The first operates through occasionally binding collateral constraints and highlights amplification effects à la Lorenzoni (2008) The second puts forward the synchronization and the compression of risk premia around the world, following Bruno and Shin (2015b). The latter comes from Calvo and Reinhart (2002). It is the potentially disruptive answer of a central bank to a foreign monetary policy. It generates misallocation, especially through mortgage spreads.

(2015) links growing financial forces over time and a gradual move from trilemma to dilemma. Another interpretation is feasible: if the shift depends on the VIX, the trilemma is valid during the boom, i.e. with low risk aversion and little uncertainty, but it transforms itself into a dilemma during the bust. If it depends on the domestic exposure to the global financial cycle as suggested by Goldberg (2013) and Cerutti et al. (2015), I investigate whether the presence of *global players* - global investors and global banks - worsen the trilemma or transform it into a dilemma. This paper demonstrates that there is no dilemma, whatever may be the dilemma's interpretation.

A second contribution is to clarify the role of the global financial cycle in the trilemma. The sensitivity to the global financial cycle depends more on the domestic presence of global investors and global banks than on the fluctuations of these financial forces. When the country goes to the worst trilemma configuration, i.e. financially open and with pegged exchange rates, the high domestic presence of one of this kind of global player doubles the initial impact of financial forces, especially for global banks. These results complement the findings of Rey (2016) and Miranda-Agrippino and Rey (2015), but differ in the intensity and the channel via which it affects monetary policy independence.

I survey the respective roles of the fluctuations and the exposure to this global financial cycle in this trilemma-dilemma debate. This paper is closely related to Goldberg (2013), Aizenman et al. (2016), Obstfeld (2015), Hofmann and Takàts (2015), Ricchi and Shi (2016), and Han and Wei (2018) who merge both approaches. Goldberg (2013) was the first to reconcile this debate between the trilemma and the dilemma through the growing role of global banks in the international financial system. By comparison, I investigate three determinants of these potential alterations of the trilemma, that is the level of the global financial cycle, the presence of global investors, and that of global banks. This literature has been influenced by Aizenman et al. (2016). They adopt a credible methodology to exhibit the determinants of the sensitivity of several financial variables, including the interest rate differential. They disentangle international, cross-country, and domestic factors. They find a greater sensitivity of interest rates for developing countries to those of more financially developed, advanced countries.[4] I take a somewhat different approach, which is closer

[4]Their proof of the trilemma view is questionable: the sensitivity of domestic emerging interest rates positively depends on a country's financial openness and, more surprisingly, on more floating exchange rate regimes. It is at odds with the trilemma, but they explain this result by the high correlation between these two choices: a country chooses a flexible exchange rate regime when it is willing to support financial pressures, that is with financial openness and well-developed domestic financial markets. As suggested by Ricchi and Shi (2016), their methodology supports

to Obstfeld (2015) and Hofmann and Takàts (2015), and focus on the potential move from the trilemma to the dilemma. For their part, these two papers test the trilemma using the interest rate differential, time fixed effects or the VIX and distinguish between short-term and long-term rates. Obstfeld (2015) establishes the aftermath of the global financial cycle, especially for emerging countries but only for long-term rates, credit, and asset prices. The global financial cycle seems not to have a significant influence on short-term interest rates, shedding light on still prevailing monetary policy trade-offs. It contrasts with Hofmann and Takàts (2015) and this paper, because both expose a causal link from the VIX to short-term interest rates. As a result, I quantify the contribution of the VIX to the year fixed effect and how it reacts when global players are included to highlight the exposure to this cycle. The VIX only explains around 20-30% of the year fixed effect in this high temporal coverage. I also assess to what extent the comovement of short-term policy rates really implies autonomy because of the high business cycles synchronization or domestic policy choices. It is in line with Ricchi and Shi (2016) and Han and Wei (2018). The latter include surprise components of the semi-annual inflation and growth forecasts, whereas I compute the correlation of business cycles and inflation cycles. Their results are also complementary to mine: Han and Wei (2018) introduce asymmetry in the trilemma-dilemma debate by distinguishing between the increase and decrease of US policy interest rates,[5] while I explore determinants of the global financial cycle.

The remainder of the paper is structured as follows. Section 2 describes the dataset. It explains the choice of exchange rate classifications and details the related methodology. Section 3 presents the estimation strategy and clarifies trilemma mechanisms. As further results, it investigates potential regime-switching through the global financial cycle. Section 4 lists some robustness checks, and Section 5 provides concluding remarks.

3.2 Data

This section provides details on data sources, including the different measures of the global financial cycle and of global players. My unbalanced panel database consists of 161 countries from

rather the idea of monetary policy spillovers than a proof of the trilemma.

[5]When the FED raises its interest rate, a more flexible exchange rate improves monetary policy independence. Yet, the opposite case is not true, suggesting a *fear of appreciation*. Nevertheless, they use a questionable data source on the exchange rate regime classification and they lump all pegged countries together. The same holds for financial openness, without a robustness check.

1970 to 2013 with 27.5 years per country on average. This sample of countries reflects all advanced economies and a large part of developing countries. Supplementary Material 3.6.1 provides a list of the countries, data sources, and descriptive statistics.

Because of growing financial forces over time, long time coverage is necessary to expose potential non-linearities. Another motive is that sensitivities to the global financial cycle fundamentally depend on the depth of domestic financial markets, as suggested by Hofmann and Takàts (2015). Thus, the unbalanced panel is not a problem because some developing countries emerged belatedly in international monetary and financial systems. Besides, I adopt annual time frequency. Some variables are monthly or even daily, but some key variables only exist in annual frequency and make no sense in higher frequency.

3.2.1 Monetary Policy Independence

Monetary policy independence is generally measured by comovement in interest rates. I use the continuous index from Aizenman et al. (2008) which depends on the annual correlation between the monthly interest rates of domestic country i and base country j. The base country is not necessarily US but depends on its own history. It is defined in Shambaugh (2004). I note monthly data by using $m \in [1, 12]$. The monetary policy independence index is defined as follows

$$MI_{it} = 1 - \frac{corr(i_{imt}, i_{jmt}) + 1}{2} \tag{3.1}$$

This index is normalized to be bounded between 0 and 1. A perfect negative correlation represents perfect monetary policy independence with the index equal to 1, while a perfect positive correlation means dependence. The process put forward by Aizenman et al. (2008) seems better than the use of a simple year interest rate differential for several reasons. First, the correlation between monthly interest rates is more informative than the first difference of year interest rate differential, used by Klein and Shambaugh (2015). Second, Aizenman et al. (2008) have taken precautions: they take into account medium-term comovement by using 3-year moving averages. In addition, they are careful with the issue of constant interest rates, because that does not necessarily mean monetary policy independence.[6]

[6] See the discussion by Aizenman et al. (2008).

This definition of monetary policy independence is debated. It is conventionally defined as the ability of countries to set their interest rates. A potential interpretation links monetary policy dependence and correlations, whether positive or negative, which in turn provides an alternative dependent variable $\widetilde{MI_{it}} =\mid corr(i_{imt}, i_{jmt}) \mid$. But positive and negative correlations do not have the same meaning. A positive correlation should reflect a high pass-through from the interest rate for the base country, whereas a negative correlation could be explained by various channels. Three arguments emerge from Ricchi and Shi (2016), namely (i) the central bank mandate, (ii) the willingness to tolerate large swings in the exchange rate (*fear of floating*) and (iii) the degree of synchronization of business cycles. For instance, the central bank may have different trade-offs between domestic/foreign objectives or inflation/unemployment.

Because of these weaknesses, I define monetary policy independence as the absence of correlation or a negative correlation if some similarities in these two countries' business cycles are included. However, an uncorrelated relationship between these two sets of interest rates provides an index equal to 0.5. Consequently, I also employ the annual year interest rate differential à la Klein and Shambaugh (2015) as a robustness test. It sharply restricts endogeneity concerns, because this methodology differentiates between the evolution of domestic and base countries, the former as the dependent variable and the latter as the explanatory variable.

Furthermore, the comovement of interest rates may not be sufficient to reflect monetary policy autonomy, as suggested by Ricchi and Shi (2016). Rey (2016) points out that the global financial cycle could also affect house prices, credit, and mortgage spreads, which in turn limit the ability of the central bank to control the domestic economy. Popper et al. (2013), Rey (2016), and Ricchi and Shi (2016) build up credible alternatives, but the comovement of short-term interest rates matters when following Klein and Shambaugh (2015), Hofmann and Takàts (2015), and Han and Wei (2018). They add Taylor rules in their specifications to prove that interest rate differentials really mean autonomy. A country with a rapid GDP growth rate or rising inflation raises its policy interest rates. Klein and Shambaugh (2015) include domestic GDP growth and the inflation rate in their robustness checks, which does not change their results about the trilemma.

I account for the correlation of interest rates by controlling for the correlation of monthly consumer price indices between domestic country i and base country j. It is the same methodology

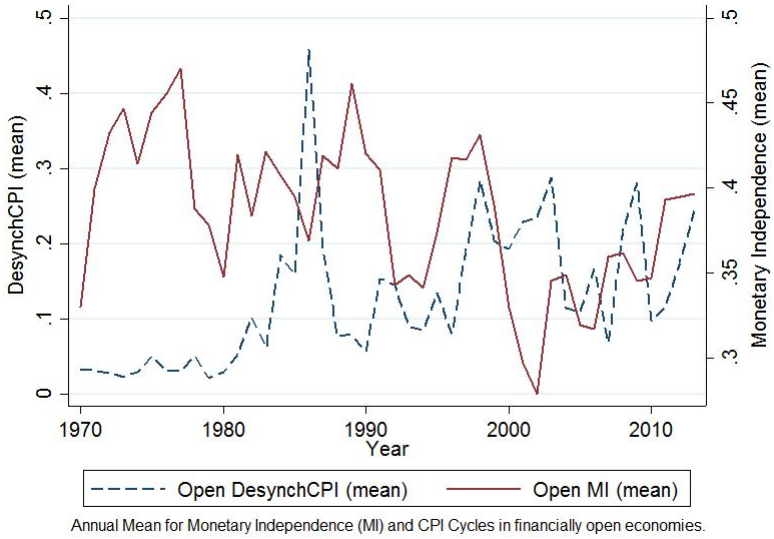


Figure 3.1: Monetary policy independence and inflation cycle desynchronization

as Aizenman et al. (2008) and the index of inflation cycle desynchronization is defined as follows

$$DesynchCPI_{it} = 1 - \frac{corr(CPI_{imt}, CPI_{jmt}) + 1}{2} \tag{3.2}$$

As a consequence, this normalized index is equal to 1 if the two countries' inflation cycles reflect a perfect negative correlation. The statistics in Supplementary Material 3.6.1 show that the mean and the volatility of this index are sufficiently relevant to warrant investigation. The comparison of these two indices of Figure 3.1 suggest a lagged correlation, probably due to inflation forecast changes or monetary policy effectiveness. This approach is in the same vein as Han and Wei (2018), but this concrete monthly data can be expected to provide additional information. For instance, the year 1986 reflects a high increase in inflation desynchronization and a drop in monetary policy independence in open economies. The disinflation policies were trending upwards with partial and heterogeneous results at the time. The decomposition of the inflation cycle according to open versus closed countries and advanced economies versus the developing world provides a similar trend in Supplementary Material 3.5.

3.2.2 Exchange rate regime

There are various exchange rate classifications. They differ because of methodologies, data sources, and objectives. Klein and Shambaugh (2006) discuss the strengths and weaknesses of each

of them. Given that I test the trilemma, I focus on the *de facto* rather than *de jure* classification. In addition, the classification from Levy-Yeyati and Sturzenegger (2005) is irrelevant in this context, because it mixes monetary policy elements, nominal exchange rate, its volatility, and the volatility of international reserves. There is the same problem with the classification of Reinhart and Rogoff (2004). The comparison of dual and official exchange rate markets induces bias, but Passari and Rey (2015) use it to test the dilemma. I select various classifications because I use both continuous and binary indexes to ensure the reliability of the results.

First of all, the core classification comes from Klein and Shambaugh (2015). They use methodologies from Shambaugh (2004) and di Giovanni and Shambaugh (2008). This binary code *Peg* indicates 1 if the country is pegged and 0 if not. A peg is globally defined in a particular year if the bilateral exchange rate between the domestic and the base country stays in a $+/-2\%$ band over the course of that year.[7] Because of the *fear of floating* à la Calvo and Reinhart (2002), I use their largest (or most positive) bilateral exchange rate variation in percentage. As an alternative, I use the *Exchange Rate Stability* continuous index from Aizenman et al. (2008) which follows the same idea as the monetary policy autonomy index. Their normalized index uses annual standard deviations of the monthly exchange rate between the domestic and the base country. Like the monetary index, Aizenman et al. (2008) do not apply it automatically. For instance, they consider the exchange rate as fixed if the annual variation in the bilateral exchange rate is higher than the $+/-2$ band in line with Klein and Shambaugh (2015). Over 45 percent (1,976 observations) reflect a peg in the binary classification from Klein and Shambaugh (2015), while over 35 percent (1,551 observations) of the sample is a peg with this continuous classification.

3.2.3 Financial Openness

Financial openness is naturally multi-dimensional. Some distinctions in these measures are potentially relevant: *de jure* or *de facto* measures, the differences between the extensity and intensity of capital controls, permanent or episodic controls, and targeted or not capital controls. The measure called *Kaopen* from Chinn and Ito (2006) is the best data source with respect to time

[7] Many improvements are feasible. For instance, di Giovanni and Shambaugh (2008) provide another dummy variable called *Kspeg*. *Peg* is a bit different from *kspeg* since the second one includes a single year peg but not discrete devaluations. In the same spirit, I could refer to the classification of intermediate exchange rate regime from Obstfeld et al. (2010) known as *softpeg*.

and geographical coverage.[8] It indicates a country's degree of capital account openness. It is based on the four binary dummy variables that codify the tabulation of restrictions on cross-border financial transactions reported in the *Annual Report on Exchange Arrangements and Exchange Restrictions* (AREAER) from the IMF. This measure is fairly broad, because it takes into account current account and capital account transactions, the presence of multiple exchange rates, and the surrender of export proceeds. It does not take into account the intensity of capital controls such as Schindler (2009), but Chinn and Ito (2006) find a correlation of 83.9 percent between them. I build a binary index *Open* with this continuous *Kaopen* in order to ensure the consistency of the results. I adopt the same conventional threshold in this literature which is 0.66, following Goldberg (2013) and Klein and Shambaugh (2015).

Contrary to Klein and Shambaugh (2015), I have no particular need of a trimodal distribution, namely always open countries, always closed countries, and middle open countries. This third group is interestingly composed of the only countries that are sometimes open and sometimes closed. Yet, this distribution between "Open", "Gates," and "Walls" according to Klein (2012) provides some bias compared to continuous indices.

3.2.4 Other Control Variables

Aizenman (2013) highlights the role of international reserves as a fourth corner, which transforms the trilemma into a quadrilemma. Similarly, Popper et al. (2013) compare the stability of various configurations of the trilemma and corroborate the fact that large international reserves extend the trilemma. The data on international reserve holdings essentially comes from the World Bank and I exclude gold reserves. I compute a ratio with the GDP as is usual in this literature. The alternative would be a normalized index or a particular threshold to distinguish between high and low levels of international reserves. Aizenman and Ito (2012) find a 21% GDP threshold level, while Klein and Shambaugh (2015) arbitrarily use a dummy if the level of international reserves is in the 75^{th} percentile of the distribution.

I control for the depth of the domestic financial system with the ratio of domestic credit provided by the financial system from the World Bank. It is straightforward that the independence of

[8] See the comparison of measures by Forbes and Warnock (2012). About the *de facto* measure, the capital flows to GDP ratio à la Lane and Milesi-Ferretti (2007) is a good option, but it raises reverse causality issues.

monetary policy strongly depends on the size of the financial sector and its linkages with the rest of the world. Yet, this measure does not highlight the heterogeneity across various economic agents. It only provides the global size of the banking sector and financial development without saying anything about their nationality, their objectives, or their granularity. I investigate this ratio with the presence of foreign lenders to clearly distinguish between national and international financial forces.

3.2.5 Global Financial Cycle, Global Investors and Global Banks

I am looking for the fluctuations and the exposure to this global financial cycle. Again, I employ both binary and continuous measures to ensure the reliability of the results. Supplementary Material 3.6.2 highlights stylized facts about these various shifts and helps to justify the thresholds chosen.

Miranda-Agrippino and Rey (2015) and Rey (2015) demonstrate that the VIX is a good proxy for the whims of the global financial cycle.[9] The VIX is the weighted average of the implied volatility of Standard and Poor's 500 index options and reflects a market estimate of future volatility. A VIX equal to 23 means that investors anticipate a feasible volatility in the next 3 months in the $+/-23\%$ band. It reflects risk aversion and uncertainty in financial markets, and began in 1970 with the Bloom (2009) methodology. Because the VIX is daily data compared to the yearly time frequency used here, I can adopt the value at the end of the year, the annual mean, or the annual volatility. Figure 3.2 in Supplementary Material 3.6.2 sheds light on these measures. If I use the value at the end, this approach drops the highest (or smallest) value of the VIX or its standard deviation during a year. For instance, information about the volatility of the VIX during the year 1987 (Black Monday) or 1998 (Russian and Asian crises) would be lost. The year 1987 was stable with a relatively low VIX until October 1987, while the year 1998 featured strong volatility. I use the log of the annual mean of the VIX. In addition, the upward trend of the VIX with an increasing amplitude over time is in line with growing financial forces over time à la Rey (2015). This argument is similar to Borio (2014): the length and amplitude of the global financial cycle depends on policy regimes. Since I am looking for potential regime-switching dynamics, I also generate a dummy

[9] Some papers try other variables such as the TED spread, the oil price, or the worldwide amount of domestic credit and cross-border credit, as I do in the robustness checks.

in order to capture the threshold value of the VIX that triggers the transmission channel. This dummy variable *Stress* is equal to 1 if the VIX is higher than its 75^{th} percentile of the distribution, that is 23. Partly for historical reasons and for the potential non-linear effect of the VIX, I employ this exogenous threshold in the baseline specification. First, a graphic analysis indicates that the dummy variable proxies the four periods of large financial instability in the last 40 years. Second, Nier et al. (2014) find that the VIX becomes the key driver of global financial flows if and only if the VIX is very high. Third, I consider the endogenous thresholds of the VIX by using a Panel Smoothing Transition Regression (PSTR) model in which the nature of the relationship between monetary independence and exchange rate regime/financial openness will depend on an endogenous threshold specific to a transition variable, namely the VIX.[10] Figure 3.2 in Supplementary Material 3.6.2 provides close thresholds to the baseline.

Goldberg (2013) emphasizes the role of global banks in the transmission channel of the global financial cycle. Avdjiev et al. (2017c) recently compared the impact of global financial conditions on cross-border loan flows and international debt securities. I investigate differences across countries in these two ways. All of the data come from the Bank for International Settlements (BIS).

First, I take into account the growing role of international debt securities. These debt securities on the money and bond markets are issued in a different country than the one where the borrower resides. Two variables are defined: the continuous ratio of international debt securities to GDP and also a binary version. There is a relatively weaker dataset for the continuous measure. It is explained by the short time coverage: it is impossible to be perfectly sure that this ratio is equal to zero when the BIS provides no data, but the role of global investors appears very weak at this time.[11] I proceed in a similar manner as the VIX and this *Global Investor* dummy variable is equal to 1 if the ratio is higher than its 75^{th} percentile of the distribution, that is 15% of the GDP. This threshold is not estimated but it appears sufficiently high in order to capture potential non-linearities. Figure 3.3 in Supplementary Material 3.6.2 illustrates this idea: there is almost no country in the 1970s and in the 1980s where the presence of global investors exceeds the threshold. I will ensure the consistency of the approach through various tests.[12]

[10] I do not use this approach as the baseline because this methodology requires a perfectly balanced database and would sharply restrict the sample to 50 countries when focusing on the VIX.

[11] In the database, the BIS data never begins with a high amount of international debt securities, which supports my assumption.

[12] The Supplementary Material tests various thresholds and makes sure that the results are not driven by outliers.

Second, I follow Goldberg (2013) and Avdjiev et al. (2017c), and use BIS International Banking Statistics (IBS). They provide two datasets, the Locational and Consolidated Banking Statistics. The first can help to prevent financial vulnerabilities à la Bruno and Shin (2015b), while the second is designed to assess the dependence of individual borrowing countries on foreign bank creditors. Consequently, I use the consolidated foreign claims of reporting banks on individual countries that correspond to the effective role of global banks in the domestic financial system. This variable is computed on an immediate counterparty basis and not on an ultimate risk basis, which is more relevant to capture adverse liquidity shock transmission, as the BIS suggests. Contrary to Goldberg (2013) who uses the share of foreign claims on local residents relative to domestic credit volumes, I consider this volume relative to the GDP in order to keep all the possible effects in the economy.[13] Again, both continuous and dummy variables are defined. The dummy variable called *Global Bank* is built with the 75^{th} percentile of the distribution, that is 35% of the GDP. It follows the same rule of selection for easier comparison and will use similar tests as used for global investors. Figure 3.4 in Supplementary Material 3.6.2 calls for this specification with only offshore financial center countries that are five times above the threshold. Nevertheless, I must caution that the global investors' data generally begins at the beginning of their presence in the country, while the data on global banks begins in 1983 in the best case. I assume that these foreign claims are low when the BIS does not provide information, given the historical trend and the earliest data provided.[14]

3.2.6 Stylized Facts

The statistics in Table 3.1 show the various shifts in financial openness and the exchange rate regime over time. It describes in detail the decomposition of conditional shifts according to the state of the global financial cycle and the presence of global investors and global banks. Over 75 percent (304) of these observations represent a shift in the exchange rate regime, but there is no

[13]The level of credit relative to the GDP is an excellent early warning indicator of financial crises and probably better than credit growth. See Schularick and Taylor (2012) and Mendoza and Terrones (2008).

[14]This methodology is employed if and only if there is no reasonable doubt. The earliest values for each country are low. In other countries, it is hard to tell whether the presence of global banks is always low or high, or when a shift appears before 1983. Thus, I restrict the database for these cases. The list of these countries beginning in 1983 with a relatively high presence of global banks is as follows: the Bahamas, Bahrain, Brazil, Chile, Costa Rica, Ivory Coast, Jamaica, Kuwait, Korea, Malaysia, Mexico, Peru, the Philippines, Portugal, and Uruguay. I test this assumption in Supplementary Material.

Table 3.1: Exchange rate and financial openness regime shifts

Shift to	Conditional on	All	Financial Stress		High presence of Global Investors		High presence of Global Banks	
			Yes	No	Yes	No	Yes	No
Exchange Rate Regime Shift								
Float → Peg	Closed	108	36	72	6	102	9	99
Peg → Float	Closed	121	37	84	6	115	5	116
Float → Peg	Open	43	13	30	7	36	12	31
Peg → Float	Open	32	11	21	3	29	8	24
Financial Openness Regime Shift								
Closed → Open	Float	54	25	29	7	47	7	47
Open → Closed	Float	20	11	9	1	19	3	17
Closed → Open	Fixed	17	5	12	2	15	4	13
Open → Closed	Fixed	8	3	5	1	7	1	7
Total		403	141	262	33	370	49	354
			35%	*65%*	*8,2%*	*91,8%*	*12,2%*	*87,8%*

clear trend in favor of a fixed or floating exchange rate. The dynamic of financial liberalization is more certain and a trimodal decomposition is feasible, consistent with Klein (2012). Some countries are (or have become)[15] persistently open, others are persistently closed (*Walls*), and the rest do not follow a simple trend of financial liberalization (*Gates*). Out of the total 74 (54+17) observations of shifts to financial openness, 41 reflect the sole shift for the country over the existing time coverage to permanent financial liberalization.[16] In addition, the relatively small number of shifts $(43 + 17)$ which leads to the open peg configuration illustrates the strength of these trilemma trade-offs.

Table 3.1 also reports the number of shifts according to the exposure of the global financial cycle. This classification puts just over one-third (35%) of these shifts in a high global financial cycle. Perhaps surprisingly, there is no clear movement to a flexible exchange rate or to financial international restrictions in these stress times and vice versa in normal times. The presence of global investors and global banks are the most discriminative with only 8.2% and 12.2% of the shifts, respectively. On the one hand, the potential statistical significance of the presence of global players could not be driven by a large number of shifts. On the other hand, it could be biased by the relative importance of one country in these specific variables, but they reflect various years and

[15]The classification of Klein (2012) is based on a 1995 to 2011 dataset. Some countries that Klein codifies as persistently open for this period may have become open in my time coverage or before.

[16]Germany, Sweden, Hong Kong, Panama, Kuwait, and Saudi Arabia have been perfectly open since 1970 or before. Consequently, they are not reported in these observations of shifts.

various countries, both advanced and emerging in almost all cases.

3.3 Results

3.3.1 Identification Strategy

The empirical setting used is close to the one proposed by Goldberg (2013) and Obstfeld (2015), but with the comovement of the policy interest rate as the dependent variable and other new control variables. I consider a measure of monetary policy independence MI_{it} with the following specification

$$\begin{aligned} MI_{it} &= \beta_0 + \beta_1\ Peg\_Open_{it} + \beta_2\ Peg\_Closed_{it} + \beta_3\ Open\_Peg_{it} + \beta_4\ Open\_Float_{it} \\ &\quad + \beta_5^{'}\ X_{it} + \beta_6^{'}\ \Theta_{it} + \mu_i + \lambda_t + \epsilon_{it} \end{aligned} \tag{3.3}$$

where μ_i is the country fixed effect and λ_t the year fixed effect. X_{it} is a vector of control variables, that is the ratio of international reserves to GDP, the depth of the domestic financial system, the extreme deviation of the bilateral exchange rate and the index of inflation desynchronization. Θ_{it} is a vector of two binary variables, *Global Investors* and *Global Banks*, which reflect the degree of international financial linkages across time and countries. The first four variables about trilemma configurations are conditional terms:[17] with the following specification, Peg_Open_{it} means for instance a shift in period t from float to peg given that the country is open in periods $t-1$ and t.

The comparison of these coefficients allows me to refine the trilemma analysis in line with Han and Wei (2018). (β_1, β_2) investigate the potential effective role of the exchange rate regime, whereas (β_3, β_4) consider capital flow management policies. International financial forces should make the monetary policy independence index drop, especially for open countries, with $|\beta_1| > |\beta_2|$. The results should be consistent with the trilemma story with a negative effect of a fixed exchange rate and financial openness, so that (β_1, β_3) should be significantly smaller than (β_2, β_4). Indeed, coefficients β_1 and β_3 reflect the impossible case of the trilemma, i.e. a financially open country

[17] This approach gives the same results as simple terms *Peg*, *Open* and the interact term. It may also generate more multicollinearity problems. By using this alternative specification in Supplementary Material, I ensure that the results are consistent with a potential multicollinearity bias. Finally, the baseline specification with conditional terms is preferable for the sake of space, and answer the timing question of trilemma mechanisms. Indeed, the interaction term should represent three possible cases, which are a shift from closed peg to open peg, a shift from open float to open peg, or a simultaneous shift from closed float to open peg.

with pegged exchange rate. Moreover, the potential difference between these two coefficients can provide new information: $|\beta_1| > |\beta_3|$ implies that the fixity of the exchange rate regime is the key ingredient in the transmission and amplification of the trilemma. By contrast, if $|\beta_1| < |\beta_3|$, the openness to international financial forces is the triggering factor of all amplification mechanisms.

A first test of this *trilemma-dilemma* debate is analyzing the potential stability of coefficients $\beta_1, \beta_2, \beta_3$, and β_4 when successively including the variables of the global financial cycle, that is the high presence of global investors, global banks, and the high level of the VIX. If the dilemma is true, the global financial cycle should deepen the effect of financial openness and sharply reduce the effect of the exchange rate regime. In absolute terms, there may even be higher coefficients β_3 and β_4, while β_1 should be reduced in times of high global financial cycle.

As a second test, I also interact trilemma and global financial cycle variables. These interaction terms will make it possible to identify the key transmission channel of this global financial cycle and to provide a new argument in this possible shift from trilemma to dilemma. If the trilemma morphs into a dilemma, the interaction terms with a high presence of global players should magnify the effect of financial openness on monetary policy independence and, at the same time, reduce the effect of a pegged exchange rate. Yet, if Obstfeld (2015) is right, the global financial cycle has amplification effects for both, including the fixity of the exchange rate regime. I employ a similar methodology to assess the role of the fluctuation of this global financial cycle by using interaction terms with a high level of VIX. It tests the hypothesis that the dilemma is relevant only for a high level of financial stress. Nevertheless, the year fixed effects should be dropped in this specific test because the VIX only varies over time by definition and is captured by year fixed effects.

Obstfeld (2015) discusses the puzzling implications of fixed effects. He notably compares estimates with year fixed effects and with the VIX. Yet, this approach with the VIX is contingent on missing explanatory variables and the coverage of the sample, following Hofmann and Takàts (2015). The comparison of estimates is sensitive if differences remain. By contrast, I propose a two-step methodology by treating the estimated year fixed effect from equation (3.3) as a dependent variable in the following equation

$$\widehat{\lambda_t} = \alpha VIX_t + \zeta_{it} \tag{3.4}$$

Coefficient α catches part of the year fixed effect explained by the VIX. The R^2 of equation (3.4) determines the extent to which this proxy of the global financial cycle could be compared to other specifications à la Obstfeld (2015). This does not require a specific methodology because the coefficients obtained from this specification with the estimated dependent variable are unbiased. As a robustness check, I also include other similar global variables traditionally used in the literature.

My strategy with the comovement of interest rates and successive fixed effects minimizes the risk of collinearity as another benefit. Klein and Shambaugh (2015) generally do not use fixed effects because their dependent variable is the first difference of the domestic interest rate and the first difference of the base country interest as one of their control variables. First, the inclusion of country fixed effects in their case only catches countries that constantly raise or lower their interest rates. By contrast, the probability that a correlation of monthly interest rates will always follow the same trend is reduced. Second, Klein and Shambaugh (2015) fear collinearity and do not use year fixed effects because of the correlation across base countries' interest rates. I expect the risk of collinearity to be lower because the correlation with monthly interest rates should be more informative.

I explore endogeneity concerns in a next step. The recent literature such as Aizenman et al. (2016) generally uses lagged values to minimize risks of potential reverse causality. The methodology of Klein and Shambaugh (2015) with this different dependent variable and the use of subsamples appears more robust to this potential endogeneity bias. All of these treatments will be used as robustness tests.

3.3.2 Baseline Results: Trilemma Mechanisms

Table 3.2 reports the baseline specification with successive fixed effects. It allow alleviating some problems. Column (1) first presents a pooled OLS specification without any fixed effects and I successively add country and year fixed effects to disentangle the various determinants of the trilemma. Without any fixed effects, the three coefficients of the trilemma cases speak for long-term coefficients. They compare pegged to not pegged countries, and open to closed countries respectively. The specification in column (2) is close to a within-estimator with country fixed effects. The inclusion of year fixed effects in other columns takes into account the waves in the co-evolution of financial openness and exchange rate regimes over time, which in turn could generate

a downward bias in the estimation of policy choices. It could be interpreted as evidence that policy choices about the exchange rate are strongly dependent on the degree of financial openness and vice versa.

Monetary independence is mainly driven by financial openness and the exchange rate regime. The policy options corresponding to the worst trilemma case sharply reduce monetary policy autonomy. This may set off an amplification of international financial pressures, according to Obstfeld et al. (2005), Aizenman et al. (2008), and Han and Wei (2018). When including country fixed effects in columns (2) and (3), the shift from float to peg diminishes the degree of monetary policy autonomy if and only if the country is financially open.

By comparison, the move from closed to open reduces monetary policy independence, whatever the exchange rate regime in column (2). These sensitivities are always ranked in the same order: the shift to peg for open countries and the shift to open for pegged countries sharply reduce monetary policy autonomy, while the shift to peg for closed countries and the shift to open for float countries have no or small effect. The comparison of β_1 and β_3 does not point at a conclusive impact of timing in terms of trilemma policies. Going into more detail, the policy decision for one country to move towards this worst trilemma configuration, i.e. financially open with pegged exchange rate, is associated with a significant 0.08 point decrease in the normalized monetary policy autonomy index. By contrast, Han and Wei (2018) find a similar ranking of coefficients over the past decade, but not for the nineties, while I employ a longer time coverage and control for country and year fixed effects.

The comparison of columns (2) and (3) does not allow to say whether the effect of financial openness only exists when the country follows a peg, but the effect is always quantitatively higher for peg than float. The puzzling differences with or without year fixed effects are probably due to the explanatory power of the VIX and thus its inability to capture all common trends. This could also be explained by the non-linear effect of the VIX in the economy, in line with Nier et al. (2014), and by the choice of the time coverage (Hofmann and Takàts, 2015): the global financial cycle and the VIX as its proxy are relatively recent growing trends according to the long time coverage used. Nevertheless, the two-step approach provides a way to quantify the effect of the VIX. This proxy of the global financial cycle explains around 20-30% of the year fixed effects, according to my specification. It is negatively correlated with the estimated year fixed effects, which in turn

suggest that high risk aversion and uncertainty generate a large global drop in monetary policy independence. Consequently, the VIX is a main driver of worldwide monetary policy independence with a global interest rates compression mechanism.

Table 3.2 also reveals that the depth of the domestic financial system is negatively correlated with monetary policy independence. Two complementary explanations are conceivable. On the one hand, this could reflect the trade-off between macroeconomic stabilization and financial stability, which can be affected by the global financial cycle. On the other hand, Schularick and Taylor (2012) demonstrate that the credit ratio is a very good predictor of financial crises. By extrapolation, these financial forces could magnify vulnerability and require a policy intervention. The role of international reserves supports the idea of a quadrilemma, following Aizenman (2013). Besides, the desynchronization of inflation cycles has no real impact, implying that the correlation of policy interest rates is a good measure of monetary policy independence. The extreme deviation of the bilateral exchange rate reduces monetary policy independence, but it never affects the effectiveness of trilemma policy decisions.

Finally, I include dummy variables that reflect the presence of global investors and global banks. Their high presence sharply reduces monetary policy independence: it is associated with a drop of 0.04 points in the normalized index. The quantitative effect is similar for both players, and maybe more importantly, this result remains almost identical in column (7) when investigating the two players at the same time. Goldberg (2013) points out their role in international shock transmission and business cycle comovements through the reduction of financial and informational frictions. She also highlights the various roles of these bank affiliates, entailing heterogeneity in the shock transmission. This could also be explained by the risk-taking channel from Bruno and Shin (2015a). The level of international reserves plays a role only for columns (3), (4) and (5), but not anymore with the high presence of global banks. Indeed, central banks hold international reserves to protect the domestic financial system against currency and banking twin crises in the spirit of Obstfeld et al. (2010). The same holds for the risk of large currency swings controlled by the exchange rate volatility. Another consequence of the presence of global players is the change in the coefficient in the second-stage estimation: the VIX loses a part of its statistical power, because it is correlated with the high presence of global players, especially global investors.

Table 3.2: Baseline specification - Trilemma mechanisms

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep. Var.	Monetary Policy Independence Index						
Peg_Open	-0.0981***	-0.0891***	-0.0843***	-0.0844***	-0.0789***	-0.0787***	-0.0747***
	(0.0208)	(0.0210)	(0.0214)	(0.0214)	(0.0216)	(0.0218)	(0.0219)
Peg_Closed	-0.0383***	-0.0108	-0.00959	-0.00988	-0.00764	-0.00798	-0.00626
	(0.0121)	(0.00995)	(0.0102)	(0.0102)	(0.0103)	(0.0102)	(0.0103)
Open_Peg	-0.117***	-0.0981***	-0.0934***	-0.0934***	-0.0850***	-0.0873***	-0.0807***
	(0.0218)	(0.0230)	(0.0218)	(0.0218)	(0.0212)	(0.0209)	(0.0205)
Open_Float	-0.0189	-0.0229*	-0.00870	-0.00879	-0.00328	-0.00807	-0.00332
	(0.0135)	(0.0127)	(0.0134)	(0.0134)	(0.0136)	(0.0136)	(0.0137)
Int. Res.	0.0663	0.0669	0.0933*	0.0932*	0.0955*	0.0781	0.0821
	(0.0418)	(0.0498)	(0.0552)	(0.0551)	(0.0569)	(0.0544)	(0.0562)
Dom. Fin.	-0.0630***	-0.0804***	-0.0690***	-0.0690***	-0.0581***	-0.0527***	-0.0452***
	(0.0145)	(0.0154)	(0.0179)	(0.0179)	(0.0175)	(0.0174)	(0.0171)
DesynchCPI	-0.00810	-0.0220*	-0.0101	-0.0100	-0.00983	-0.0115	-0.0111
	(0.0170)	(0.0118)	(0.0123)	(0.0123)	(0.0125)	(0.0124)	(0.0126)
Extreme Volat.	-0.000247	-0.00107**		-0.000918*	-0.000837*	-0.000790	-0.000736
	(0.000730)	(0.000481)		(0.000505)	(0.000497)	(0.000485)	(0.000483)
VIX (log)	0.000839	-0.00220					
	(0.0104)	(0.00999)					
Global Investors					-0.0557***		-0.0489***
					(0.0151)		(0.0148)
Global Banks						-0.0492***	-0.0427***
						(0.0127)	(0.0126)
Constant	0.503***	0.514***	0.518***	0.518***	0.509***	0.516***	0.508***
	(0.0328)	(0.0326)	(0.0165)	(0.0165)	(0.0172)	(0.0166)	(0.0174)
Country FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	Yes	Yes	Yes	Yes	Yes
P-value $\beta_1 = \beta_3$	0.612	0.808	0.803	0.805	0.868	0.811	0.867
Second-stage							
VIX(log)			-0.0078***	-0.0078***	-0.0056***	-0.0071***	-0.0053***
% of Year FE			0.307	0.308	0.195	0.285	0.184
Obs.	4427	4427	4427	4427	4427	4427	4427
Countries	161	161	161	161	161	161	161
adj. R^2	0.202	0.111	0.150	0.150	0.157	0.156	0.162

With the within estimator, Peg_Open means a shift from float to peg given that a country is open.

With the within estimator, Open_Peg means a shift from closed to open given that a country is pegged.

*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

Robust standard errors in parentheses.

3.3.3 Looking for the Role of Global Players

Tables 3.3 and 3.4 highlight the effects of these conditional terms according to the domestic presence of global investors and global banks. I interact these 4 cases with dummies representing the relative importance of global investors and global banks, respectively. First of all, these trilemma shifts with any global players are consistent with the previous table. The sensitivities follow the same ranking, and the changes across columns are explained by the successive interaction terms. The set of control variables provides similar results as in Table 3.2 with negative and statistically significant effects of the national and international financial systems through the size of the domestic financial system and the VIX. The inclusion of global investors in Table 3.3 reduces the leading role of the VIX, whereas the inclusion of global banks in Table 3.4 does not aim to compete with the power of the fluctuations of the global financial cycle.

The presence of global investors *per se* generally affects monetary policy independence according to Table 3.3. When the money and bond markets clearly depend on global investors, the two shifts corresponding to the worst case in trilemma configurations have strong effects on the Central Bank's ability to implement its own monetary policy. Therefore, it can be concluded here that the high presence of global investors on the money and bond domestic markets worsens trilemma trade-offs. When a country goes to the worst configuration, financial forces cut monetary policy independence by around 0.07 point without global investors, and cut by 0.13 point with these global investors. This is an amplification effect which almost doubles the initial forces. However, the comparison between on the one hand columns (3) and (6) and on the other hand column (7) suggests multicollinearity, which in turn affects the quantitative results. There is probably not enough information in the data to estimate the model accurately. The use of dummy variables is one plausible explanation, but the results are consistent in the first six columns. Another consequence of multicollinearity is the over- and underestimation of the correlated coefficients. This could explain why the impact of global investors *per se* does not seem robust when using multiple interaction terms in columns (6) and (7).

In contrast to global investors, the presence of global banks *per se* seems to have no impact on monetary policy autonomy contrary to Table 3.2, suggesting that global banks worsen the trilemma in some specific trilemma configurations. The move to peg for open countries has greater

consequences with global banks, while the trilemma is the same for closed countries following a similar shift. Potential international financial pressures from specific exchange rate regimes do not increase with specific capital controls and prudential regulation. Column (2) suggests that the high presence of global banks could even reduce the drop in monetary policy independence for a closed country following this exchange rate regime shift. Yet, this effect is statistically significant only at 10% and it disappears in column (3). By comparison, the decision to open current and capital accounts when a large part of claims comes from global banks sharply restricts monetary policy independence in columns (4) and (6). The comparison between columns (5), (6), and (7) raises questions about their hypothetical role for a shift to open for pegged countries. It brings to the worst configuration and the domestic country should feel the full brunt of the global financial cycle, but it becomes statistically insignificant. The small number of these particular policy decisions also supports the idea of multicollinearity. With this assumption, the interaction terms with global investors could be considered as a placebo test to ensure the consistency of the results. As a consequence, the high presence of global banks lifts the drop in monetary policy independence in three policy shifts. The shift from closed float to open float leads to a decrease of 0.06 point in the normalized index without a high presence of global banks. With these players, it seems that the effect has more than doubled. The shift from open float to open peg leads to a similar drop of 0.15 points in the high presence of these global banks, and 0.05 points if not. I also investigate the use of global investors and global banks at the same time. These results are not reported for the sake of concision, but all previous results are consistent.

3.3.4 Looking for the Fluctuations of the Global Financial Cycle

Table 3.5 focuses on another assumption, in connection with the dilemma from Passari and Rey (2015). I test whether this shift depends on the fluctuations of the global financial cycle: the trilemma is valid during the boom, i.e. with low risk aversion and little uncertainty, but it transforms into a dilemma during the bust. Because it is a cycle and not a linear temporal trend, I use the variation of the VIX and exploit moments of highest risk aversion with the *Stress* dummy variable.

This table supports the previous results with the same ranking of the trilemma configurations. Taken together, it provides compelling evidence that the assumption about a move between

Table 3.3: Looking for the role of Global Investors

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep. Var.	Monetary Policy Independence Index						
Peg_Open	-0.0648***	-0.0773***	-0.0649***	-0.0737***	-0.0766***	-0.0736***	-0.0676***
	(0.0225)	(0.0217)	(0.0226)	(0.0215)	(0.0214)	(0.0214)	(0.0228)
Peg_Closed	-0.00796	-0.00967	-0.00887	-0.00788	-0.00730	-0.00784	-0.00923
	(0.0102)	(0.0105)	(0.0104)	(0.0102)	(0.0103)	(0.0102)	(0.0104)
Open_Peg	-0.0764***	-0.0832***	-0.0762***	-0.0676***	-0.0825***	-0.0681***	-0.0737***
	(0.0206)	(0.0211)	(0.0206)	(0.0219)	(0.0213)	(0.0218)	(0.0229)
Open_Float	-0.00586	-0.00170	-0.00511	-0.00561	-0.0102	-0.00656	-0.00700
	(0.0133)	(0.0136)	(0.0132)	(0.0133)	(0.0138)	(0.0138)	(0.0139)
Int. Res.	0.0937	0.0970*	0.0944	0.0942	0.0945	0.0941	0.0946
	(0.0585)	(0.0571)	(0.0586)	(0.0586)	(0.0575)	(0.0586)	(0.0586)
Dom. Fin.	-0.0556***	-0.0567***	-0.0552***	-0.0554***	-0.0587***	-0.0556***	-0.0554***
	(0.0172)	(0.0175)	(0.0172)	(0.0172)	(0.0172)	(0.0174)	(0.0174)
DesynchCPI	-0.00843	-0.00928	-0.00827	-0.00858	-0.00987	-0.00864	-0.00835
	(0.0128)	(0.0128)	(0.0129)	(0.0127)	(0.0125)	(0.0127)	(0.0128)
Global Investor	-0.0343**	-0.0613***	-0.0377**	-0.0351**	-0.0685***	-0.0379	-0.0462
	(0.0170)	(0.0159)	(0.0181)	(0.0166)	(0.0187)	(0.0240)	(0.0305)
Peg_Open x Global Inv	-0.0650**		-0.0616**				-0.0376
	(0.0308)		(0.0311)				(0.0486)
Peg_Closed x Global Inv		0.0391	0.0160				0.0241
		(0.0351)	(0.0354)				(0.0395)
Open_Peg x Global Inv				-0.0643**		-0.0614*	-0.0161
				(0.0302)		(0.0353)	(0.0406)
Open_Float x Global Inv					0.0338	0.00511	0.0124
					(0.0251)	(0.0285)	(0.0334)
Constant	0.506***	0.508***	0.506***	0.506***	0.509***	0.507***	0.507***
	(0.0174)	(0.0173)	(0.0174)	(0.0174)	(0.0172)	(0.0174)	(0.0175)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Second-stage							
VIX(log)	-0.0059***	-0.0059***	-0.0060***	-0.0060***	-0.0054**	-0.0060***	-0.0060***
% of Year FE	0.209	0.211	0.215	0.215	0.184	0.213	0.215
Obs.	4427	4427	4427	4427	4427	4427	4427
Countries	161	161	161	161	161	161	161
adj. R^2	0.160	0.157	0.160	0.160	0.158	0.159	0.159

With the within estimator, Peg_Open means a shift from float to peg given that a country is open.

With the within estimator, Open_Peg means a shift from closed to open given that a country is pegged.

*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

Robust standard errors in parentheses.

Table 3.4: Looking for the role of Global Banks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep. Var.	Monetary Policy Independence Index						
Peg_Open	-0.0400*	-0.0772***	-0.0400*	-0.0691***	-0.0796***	-0.0712***	-0.0489**
	(0.0224)	(0.0219)	(0.0223)	(0.0218)	(0.0219)	(0.0216)	(0.0228)
Peg_Closed	-0.00844	-0.0111	-0.00851	-0.00857	-0.00772	-0.00865	-0.00521
	(0.0101)	(0.0102)	(0.0102)	(0.0102)	(0.0102)	(0.0102)	(0.0104)
Open_Peg	-0.0717***	-0.0850***	-0.0717***	-0.0414*	-0.0879***	-0.0355	-0.0537**
	(0.0201)	(0.0208)	(0.0201)	(0.0214)	(0.0211)	(0.0216)	(0.0225)
Open_Float	-0.0119	-0.00680	-0.0118	-0.0109	-0.00415	0.00371	0.00580
	(0.0132)	(0.0137)	(0.0134)	(0.0131)	(0.0145)	(0.0146)	(0.0148)
Int. Res.	0.0646	0.0771	0.0646	0.0615	0.0785	0.0598	0.0606
	(0.0531)	(0.0544)	(0.0531)	(0.0527)	(0.0545)	(0.0524)	(0.0525)
Dom. Fin.	-0.0479***	-0.0520***	-0.0479***	-0.0481***	-0.0525***	-0.0469***	-0.0463***
	(0.0172)	(0.0175)	(0.0172)	(0.0172)	(0.0175)	(0.0173)	(0.0172)
DesynchCPI	-0.0121	-0.0119	-0.0121	-0.0129	-0.0114	-0.0129	-0.0120
	(0.0123)	(0.0124)	(0.0123)	(0.0123)	(0.0124)	(0.0123)	(0.0124)
Global Banks	-0.0203	-0.0578***	-0.0205	-0.0210*	-0.0453***	-0.000427	0.0193
	(0.0128)	(0.0139)	(0.0141)	(0.0126)	(0.0150)	(0.0154)	(0.0193)
Peg_Open x Global Bk	-0.126***		-0.126***				-0.100**
	(0.0212)		(0.0222)				(0.0500)
Peg_Closed x Global Bk		0.0367*	0.000795				-0.0381
		(0.0221)	(0.0218)				(0.0253)
Open_Peg x Global Bk				-0.129***		-0.151***	-0.0738
				(0.0199)		(0.0221)	(0.0457)
Open_Float x Global Bk					-0.0159	-0.0625***	-0.0820***
					(0.0224)	(0.0231)	(0.0268)
Constant	0.512***	0.517***	0.512***	0.513***	0.516***	0.512***	0.509***
	(0.0169)	(0.0166)	(0.0168)	(0.0167)	(0.0167)	(0.0170)	(0.0172)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Second-stage							
VIX(log)	-0.0072***	-0.0074***	-0.0072***	-0.0074***	-0.0073***	-0.0080***	-0.0077***
% of Year FE	0.293	0.300	0.293	0.306	0.292	0.339	0.327
Obs.	4427	4427	4427	4427	4427	4427	4427
Countries	161	161	161	161	161	161	161
adj. R^2	0.168	0.157	0.168	0.168	0.156	0.171	0.172

With the within estimator, Peg_Open means a shift from float to peg given that a country is open.

With the within estimator, Open_Peg means a shift from closed to open given that a country is pegged.

*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

Robust standard errors in parentheses.

trilemma and dilemma according to the VIX is not valid. This result does not mean that the fluctuations of the global financial cycle are irrelevant, because the VIX is mainly at a high level of statistical significance in the two-step approach. The estimated year fixed effects are driven by the VIX, meaning that a high VIX sharply reduces trilemma trade-offs for policymakers. Yet, the statistical insignificance of interaction terms with *Stress* in Table 3.5 should be compared with the results in Tables 3.3 and 3.4, especially with global banks.

It could be argued that the *Stress* variable is not correctly specified, but Nier et al. (2014) demonstrate that the VIX becomes the main driver of capital flows when the VIX is very high and Table 3.25 checks other thresholds in Supplementary Material 3.9.

To sum up, it means that a high level of risk aversion and uncertainty probably make monetary policy independence drop. Yet, the impact of policymakers' decisions about financial openness and the exchange rate regime are more driven by the exposure of the global financial cycle through global players than by the VIX.

3.4 Robustness

3.4.1 Alternative Specification and Endogeneity Issues

It can be argued that the identification strategy suffers from reverse causality issues because the stance of monetary policy is perhaps a determinant of financial openness and the exchange rate regime. The lagged explanatory variables used by Aizenman and Ito (2014) and Aizenman et al. (2016) are not entirely convincing because of the persistence of these variables. By contrast, I employ the methodology in Klein and Shambaugh (2015) as an alternative specification which is more robust to the endogeneity bias. They consider the following specification

$$\Delta R_{it} = \alpha + \beta \Delta R_{bit} + \epsilon_{it} \tag{3.5}$$

where ΔR_{it} and ΔR_{bit} are the annual first difference of the interest rate for the domestic country and base country, respectively. An increase in $\hat{\beta}$ means a decrease in monetary policy independence, following the discussion and conditions of Klein and Shambaugh (2015). They compare $\hat{\beta}$ and the R^2 statistic across subsamples by differentiating the four trilemma configurations. I present these

Table 3.5: Looking for the fluctuations of the Global Financial Cycle

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	Monetary Policy Independence Index					
Peg_Open	-0.0795***	-0.0654***	-0.0871***	-0.0719***	-0.0726***	-0.0581**
	(0.0226)	(0.0230)	(0.0214)	(0.0221)	(0.0228)	(0.0232)
Peg_Closed	-0.0104	-0.00677	-0.0106	-0.00667	-0.00773	-0.00442
	(0.0106)	(0.0106)	(0.00991)	(0.00989)	(0.0106)	(0.0106)
Open_Peg	-0.0963***	-0.0802***	-0.0893***	-0.0743***	-0.102***	-0.0863***
	(0.0231)	(0.0212)	(0.0229)	(0.0212)	(0.0271)	(0.0255)
Open_Float	-0.0224*	-0.0107	-0.0151	-0.00401	-0.0140	-0.00319
	(0.0127)	(0.0133)	(0.0134)	(0.0136)	(0.0135)	(0.0138)
Int. Res.	0.0662	0.0789	0.0657	0.0784	0.0647	0.0776
	(0.0496)	(0.0498)	(0.0496)	(0.0498)	(0.0496)	(0.0498)
Dom. Fin.	-0.0801***	-0.0439***	-0.0799***	-0.0438***	-0.0802***	-0.0441***
	(0.0153)	(0.0149)	(0.0152)	(0.0149)	(0.0152)	(0.0148)
DesynchCPI	-0.0182	-0.0169	-0.0181	-0.0168	-0.0176	-0.0164
	(0.0116)	(0.0118)	(0.0116)	(0.0119)	(0.0117)	(0.0119)
Stress	-0.00182	0.000617	0.00129	0.00376	0.00576	0.00739
	(0.00837)	(0.00831)	(0.00667)	(0.00673)	(0.00962)	(0.00966)
Global Investors		-0.0546***		-0.0546***		-0.0545***
		(0.0146)		(0.0146)		(0.0146)
Global Banks		-0.0471***		-0.0469***		-0.0468***
		(0.0121)		(0.0120)		(0.0120)
Peg_Open x Stress	-0.0264*	-0.0222			-0.0528	-0.0503
	(0.0159)	(0.0149)			(0.0443)	(0.0420)
Peg_Closed x Stress	-0.000927	0.000102			-0.00854	-0.00672
	(0.0125)	(0.0125)			(0.0134)	(0.0134)
Open_Peg x Stress			-0.0266	-0.0224	0.0201	0.0226
			(0.0161)	(0.0149)	(0.0469)	(0.0439)
Open_Float x Stress			-0.0167	-0.0154	-0.0211	-0.0190
			(0.0149)	(0.0145)	(0.0160)	(0.0156)
Constant	0.507***	0.494***	0.506***	0.493***	0.505***	0.492***
	(0.0134)	(0.0133)	(0.0132)	(0.0132)	(0.0134)	(0.0134)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	No	No
Obs.	4427	4427	4427	4427	4427	4427
Countries	161	161	161	161	161	161
adj. R^2	0.112	0.128	0.112	0.128	0.112	0.128

With the Within estimator, Peg_Open means a shift from float to peg given that a country is open.

With the Within estimator, Open_Peg means a shift from closed to open given that a country is pegged.

*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

Robust standard errors in parentheses.

four cases and distinguish between them by the fluctuations and the exposure to the global financial cycle.

Tables 3.6 and 3.7 consider the four trilemma cases according to the high presence of global investors and global banks, while Table 3.8 focuses on a time decomposition according to the high or low level of financial stress around the world. These tables support trilemma mechanisms, especially the lack of monetary policy independence in open pegged countries. It also supports the main result: the high presence of global players magnifies trilemma trade-offs when the country is on the worst trilemma configuration, while the level of the VIX does not play a key role in this potential shift. Perhaps surprisingly, I find differences in the closed peg subsample and a significant $\hat{\beta}$ if and only if there is a low presence of these global players. However, the two subsamples are overly unbalanced. In the same way, the unanticipated coefficients on the open float subsample according to the level of financial stress could be explained by other factors, such as the differences in the presence of these two players.

Table 3.6: Other specification à la Klein and Shambaugh (2015) - Sensitivity analysis

	Open Peg		Open Float		Closed Peg		Closed Float	
	β	Obs.	β	Obs.	β	Obs.	β	Obs.
	(s.e.)	$[R^2]$	(s.e.)	$[R^2]$	(s.e.)	$[R^2]$	(s.e.)	$[R^2]$
Global Investors	0.84***	200	0.31	240	-0.21	86	-0.65	73
	(0.07)	[0.57]	(0.15)	[0.003]	(0.28)	[0.002]	(0.54)	[0.007]
No Gl. Investors	0.55***	291	0.18	542	0.48***	883	5258	1072
	(0.09)	[0.16]	(0.15)	[0.004]	(0.08)	[0.006]	(5242)	[0.000]
Gl. Investors vs No	0.28**		0.12		-0.65**		-5224	

Subsample regressions of the form $\Delta R_{it} = \alpha + \beta \Delta R_{bit} + \epsilon_{it}$. The term *Global Investors* means that the presence of foreign investors in domestic money and bond markets is higher than 15% of their domestic GDP. Entries in marginal row based on an interaction regression.
*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

3.4.2 Additional Robustness

The Supplementary Material investigates the robustness of my results. They are unaffected by (i) reducing multicollinearity concerns through simpler trilemma decision variables; (ii) controlling for the assumptions and the various thresholds of the exposure to the global financial cycle ; (iii) using alternative measures and thresholds of the fluctuations to the global financial cycle; (iv) endogenizing a threshold of the fluctuations to the global financial cycle; (v) including different measures

Table 3.7: Other specification à la Klein and Shambaugh (2015) - Sensitivity analysis

	Open Peg		Open Float		Closed Peg		Closed Float	
	β	Obs.	β	Obs.	β	Obs.	β	Obs.
	(s.e.)	$[R^2]$	(s.e.)	$[R^2]$	(s.e.)	$[R^2]$	(s.e.)	$[R^2]$
Global Banks	0.81***	224	0.25**	228	0.24	176	12905	106
	(0.06)	[0.44]	(0.12)	[0.02]	(0.09)	[0.05]	(4888)	[0.02]
No Gl. Banks	0.51***	260	0.17	541	0.49***	735	4914	1000
	(0.10)	[0.15]	(0.20)	[0.002]	(0.09)	[0.004]	(4888)	[0.000]
Gl. Banks vs No	0.30***		0.03		-0.30		5343	

Subsample regressions of the form $\Delta R_{it} = \alpha + \beta \Delta R_{bit} + \epsilon_{it}$. The term *Global Banks* means that the presence of foreign global banks in a domestic economy is higher than 35% of their domestic GDP. Entries in marginal row based on an interaction regression.
*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

Table 3.8: Other specification à la Klein and Shambaugh (2015) - Sensitivity analysis

	Open Peg		Open Float		Closed Peg		Closed Float	
	β	Obs.	β	Obs.	β	Obs.	β	Obs.
	(s.e.)	$[R^2]$	(s.e.)	$[R^2]$	(s.e.)	$[R^2]$	(s.e.)	$[R^2]$
Stress	0.52***	221	-0.43	369	0.31**	359	1.70	462
	(0.09)	[0.16]	(0.26)	[0.008]	(0.14)	[0.01]	(1.49)	[0.003]
No Stress	0.71***	270	0.58***	413	0.48***	610	7209	685
	(0.10)	[0.27]	(0.14)	[0.06]	(0.10)	[0.007]	(7211)	[0.000]
Stress vs No	-0.17		-0.93**		-0.16		-7263	

Subsample regressions of the form $\Delta R_{it} = \alpha + \beta \Delta R_{bit} + \epsilon_{it}$. The term *Stress* means that the global risk aversion and uncertainty around the world is high, namely the VIX is higher than 23.
Entries in marginal row based on an interaction regression.
*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

for the correlation of GDP and inflation cycles; (vi) using alternative definition of monetary policy independence; (vii) using financial variables (credit volumes, house prices, and equity indices) as dependent variable; and (viii) controlling for financial crises and country size.

3.5 Conclusion

Trilemma does not morph into a dilemma. In contrast to Rey (2015), the global financial cycle worsens trilemma configurations, especially when global investors and global players play a major role in the domestic economy. The sensitivity to the global financial cycle depends less on the fluctuations of these financial forces than on the presence of global investors and global banks. The presence *per se* of global players generally does not worsen the trilemma, but their presence, associated with specific policymaker decisions, exacerbates these trade-offs. This paper

also confirms that the comovement of policy interest rates is a good proxy of monetary policy independence.

The central bank mandate of biggest economies does not contain explicit reference to international objectives such as the resilience of international financial system. Conversely, they focus on domestic targets and neglect potential international spillovers from their policies, as discussed by Bernanke (2017), among others. Small open countries have various policy tools to isolate their domestic financial system to these spillovers, but the choice between different macroprudential tools and capital controls is not easy. In the same way, the choice of exchange rate regime crucially depends on the willingness to accept disinflation policies.

The findings of this paper illustrate the importance of global players for the international monetary and financial system, and calls for more macroprudential regulation. The resilience of domestic economies depends less on a monotonic degree of financial liberalization than on the effectiveness of capital flow management. There are a number of issues that are beyond the scope of this paper. First, it focuses on the traditional Mundellian trilemma in this new world, whereas monetary policy combines goals of monetary stability and financial stability. I include financial forces but do not explicitly interact this trilemma with the financial trilemma. Second, there is a complementary strand in the literature that focuses on central bank characteristics: for instance, the sensitivity of domestic economies to these financial forces could depend on the governors of central banks.

3.6 Supplementary Material

3.6.1 Descriptive Statistics, Data Sources and List of Countries

Table 3.9: Descriptive statistics

Variable	Obs.	Countries	Mean	Std. Dev.	Min	Max
Monetary Policy Autonomy						
MI	4427	161	0.432	0.183	0	0.967
DesynchCPI	4427	161	0.161	0.207	0.00009	0.998
SyncInfl (annual)	4385	160	0.834	0.277	0.0002	1
SyncGDP (annual)	4400	161	0.911	0.226	0.002	1
$\widetilde{MI}$ (alternative)	4427	161	0.292	0.260	0	1
Policy Choices: Binary vs Continuous Indices						
Peg (binary)	4427	161	0.448	0.497	0	1
Open (binary)	4427	161	0.349	0.477	0	1
ERS (continuous)	4427	161	0.622	0.321	0.005	1
Kaopen (continuous)	4427	161	0.466	0.355	0	1
Control Variables						
Int. Reserves/GDP	4427	161	0.137	0.158	0.00009	1.567
Domestic Financial/GDP	4427	161	0.584	0.496	-0.791	3.665
Extreme Volatility	4427	161	0.09	1.62	-0.004	104.16
Role of Global Investors: International Debt Securities						
IDS/GDP (continuous)	2734	111	0.148	0.353	0	5.571
Global Investors (binary)	4427	161	0.162	0.368	0	1
Role of Global Banks: Consolidated Foreign Claims						
CFC/GDP (continuous)	3552	158	0.502	1.984	0.00009	42.368
Global Banks (binary)	4427	161	0.217	0.413	0	1
Global Financial Cycle						
VIX (mean, log)	4427	161	3.0	0.292	2.39	3.60
VIX (std)	4427	161	4.269	3.555	0.916	16.972
Stress (binary)	4427	161	0.386	0.487	0	1
Oil Price (mean, log)	4427	161	1.556	0.348	0.447	2.123
TED spread (mean)	3558	159	0.598	0.365	0.19	1.55
Effective Monetary Policy Autonomy						
PrivateCredit/GDP	4418	161	0.457	0.415	0.007	3.122
House Price Index (real, log)	1238	56	1.876	0.185	0.802	2.31
Equity Index (nom., log)	1703	67	2.688	1.002	-1.698	5.052

Table 3.10: Data sources

Variable	Description	Source
	Monetary Policy Autonomy	
MI	Continuous normalized index based on the annual correlation between the monthly interest rate of the domestic and the base country.	Aizenman et al. (2008) updated
$\widetilde{MI}$	Alternative continuous normalized measure based on the absolute value of the correlation.	Aizenman et al. (2008) updated, and author's calculation
DesynchCPI	Similar methodology with monthly CPI.	IMF, CB, Datastream
SyncInfl	Annual CPI growth.	IMF, CB, Datastream
SyncGDP	Annual GDP growth.	World Bank, Datastream
	Policy Choices: Binary vs Continuous Indices	
Peg	Binary index based on the annual standard deviations of the monthly exchange rate of the domestic and the base country.	Klein and Shambaugh (2015)
ERS	Continuous normalized index based on close methodology.	Aizenman et al. (2008) updated
Open	Binary *de jure* measure of financial liberalization. Threshold based on Goldberg (2013) and Klein and Shambaugh (2015).	Aizenman et al. (2008) updated
Kaopen	Continuous *de jure* measure of financial liberalization.	Aizenman et al. (2008) updated
	Control Variables	
Int. Res./GDP	Ratio of international reserves to GDP, excluding gold.	World Bank, CB
Dom. Fin./GDP	Domestic credit provided by financial sector. It measures banking sector depth and financial sector development in terms of size.	World Bank
Extreme Volat.	Largest (or most positive) % monthly bilateral exchange rate change.	Klein and Shambaugh (2015)
	Role of Global Investors: International Debt Securities	
IDS/GDP	International debt securities are borrowing in money and bond markets are those issued in a market other than the local market of the country where the borrower resides. Only resident issuers. These amount and GDP are in US current dollar.	BIS, author's calculation
Global Investors	Binary version. Equal to 1 if ratio is higher than its 75^{th} percentile of the distribution, that is 15% of GDP.	BIS, author's calculation
	Role of Global Banks: Consolidated Foreign Claims	
CFC/GDP	Consolidated foreign claims of reporting banks on individual countries that corresponds to the effective role of global banks in the domestic financial system. These amount and GDP are in US current dollar. Computed on immediate counterparty basis.	BIS, author's calculation
Global Banks	Binary version. Equal to 1 if ratio is higher than its 75^{th} percentile of the distribution, that is 35% of GDP.	BIS, author's calculation
	Global Financial Cycle	
VIX	Conventional measure of risk aversion based on S&P 500 index options. Proxy for uncertainty.	Bloom (2009) updated
Stress	Binary measure. Equal to 1 if ratio is higher than its 75^{th} percentile of the distribution, that is 23.	Author's calculation.
Oil Price	World Crude Oil, US dollars.	Datastream
TED spread	Percent, annual mean.	FED St Louis
	Effective Monetary Policy Autonomy	
Pri. Cred./GDP	Domestic credit to private sector as a share of GDP. It refers to financial resources provided to the private sector by financial corporations.	World Bank
House Prices	Real house price index.	BIS, Cesa-Bianchi website,
Equity	Nominal equity index.	Datastream, MSCI, Schularick and Taylor (2012)

Table 3.11: List of countries - First part

West Europe, North Am.		Europe and Central Asia		South,East Asia and Pacific	
Austria	1970-2013	Albania	1996-2013	Australia	1970-2013
Belgium	1970-2012	Armenia	1996-2013	Bangladesh	1993-2012
Canada	1970-2008	Azerbaijan	2009-2013	Bhutan	2004-2013
Denmark	1970-2013	Belarus	1996-2013	China	1986-2013
France	1970-2013	Bulgaria	1994-2013	Fiji	1975-2009
Finland	1970-2013	Croatia	1996-2013	Hong Kong	1990-2013
Germany	1970-2013	Cyprus	1975-2012	India	1970-2013
Greece	1970-2013	Czech Rep.	1995-2013	Indonesia	1983-2013
Iceland	1983-2013	Estonia	1996-2010	Japan	1970-2013
Italy	1970-2013	Georgia	1996-2013	Korea	1983-2013
Ireland	1976-2013	Hungary	1991-2013	Lao PDR	1989-2010
Malta	1972-2013	Kazakhstan	1996-2013	Malaysia	1983-2013
Netherlands	1970-2013	Kyrgyz Rep.	1997-2007	Maldives	2006-2013
Norway	1970-2006	Latvia	1996-2012	Micronesia St.	2008-2012
Portugal	1983-2013	Lithuania	1996-2012	Nepal	1974-2013
Spain	1970-2013	Mongolia	1995-2013	New Zealand	1983-2010
Sweden	1970-2013	Moldova	1996-2013	Pakistan	1970-2013
Switzerland	1995-2013	Poland	1991-2013	Papua New Guinea	2010-2013
United Kingdom	1970-2013	Romania	1994-2013	Philippines	1983-2013
		Russian Fed.	1996-2013	Samoa	1983-2012
		Slovak Rep.	1996-2008	Singapore	1983-2013
		Slovenia	1996-2012	Solomon Island	1982-2013
		Tajikistan	2000-2013	Sri Lanka	1970-2012
		Turkey	1970-2013	Thailand	1997-2013
		Ukraine	1996-2013	Tonga	1990-2013
				Vanuatu	2000
				Vietnam	1996-2012

Table 3.12: List of countries - Second part

Latin America and Caribbean		Middle East,North Africa and Sub-Saharan Africa			
Antigua and Barb.	1998-2009	Algeria	1974-2013	Guinea-Bisseau	1987-2012
Argentina	1988-2013	Djibouti	1997-2007	Guinea	2004-2005
Bahamas	1983-2012	Egypt, Rep	1970-2013	Kenya	1970-2013
Barbados	1983-2009	Iran	1970-1979	Lesotho	2002-2013
Belize	1985-2013	Israel	1982-2013	Liberia	2001-2012
Bolivia	1970-2013	Jordan	1976-2012	Madagascar	1970-2012
Brazil	1983-2013	Kuwait	1970-2013	Malawi	1980-2012
Chile	1983-2013	Lebanon	2008-2012	Mauritanie	1985-2012
Colombia	1970-2013	Libya	2001-2009	Mauritius	1976-2013
Costa Rica	1983-2013	Morocco	1970-2013	Mozambique	1994-2013
Dominica	1982-2013	Oman	2004-2013	Namibia	2002-2013
Dominican Rep.	1970-2013	Qatar	2003-2013	Niger	1970-2012
El Salvador	1970-2012	Saudi Arabia	1997-2012	Nigeria	1970-2013
Grenada	1981-2013	Tunisia	1987-2012	Rwanda	1970-2005
Guatemala	1970-2013	Angola	1995-2013	Sao Tome	2001-2013
Guyana	1994-2013	Benin	1992-2012	Senegal	1970-2012
Haiti	1994-2013	Botswana	1976-2013	Seychelles	1981-2013
Honduras	1979-2013	Burkina Faso	1988-2012	Sierra Leone	2006-2013
Jamaica	1983-2013	Burundi	1977-2013	South Africa	1970-2013
Mexico	1983-2013	Cameroon	1970-2013	Sudan	1978-1984
Nicaragua	1999-2013	Cape Verde	1992-2013	Swaziland	1974-2013
Panama	1986-2013	Central Afr. Rep.	1981-2013	Tanzania	1988-2013
Paraguay	1990-2013	Chad	1983-2013	Togo	1970-2012
Peru	1983-2012	Congo Rep.	1984-2013	Uganda	1992-2013
St Kitts and N.	1998-2013	Congo Dem. Rep.	1982-2012	Zambia	1985-2013
St Lucia	1983-2013	Ivory Coast	1983-2012	Zimbabwe	1995-2005
St Vincent	1985-2008	Equatorial Guinea	1985-2013		
Suriname	1991-2013	Ethiopia	1985-2008		
Trinidad and Tob.	1983-2009	Gabon	1970-2013		
Uruguay	1983-2013	Gambia	1977-2013		
Venezuela	2008-2013	Ghana	1970-2013		

3.6.2 Stylized Facts

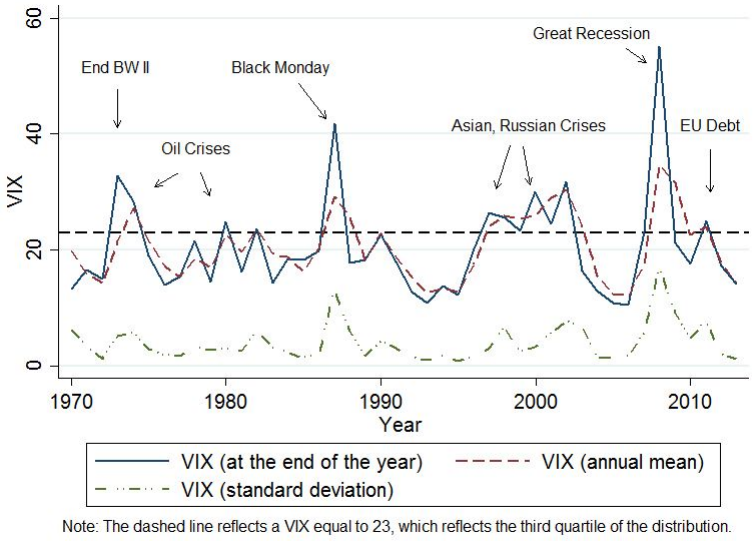


Figure 3.2: The Global Financial Cycle: various measures and thresholds

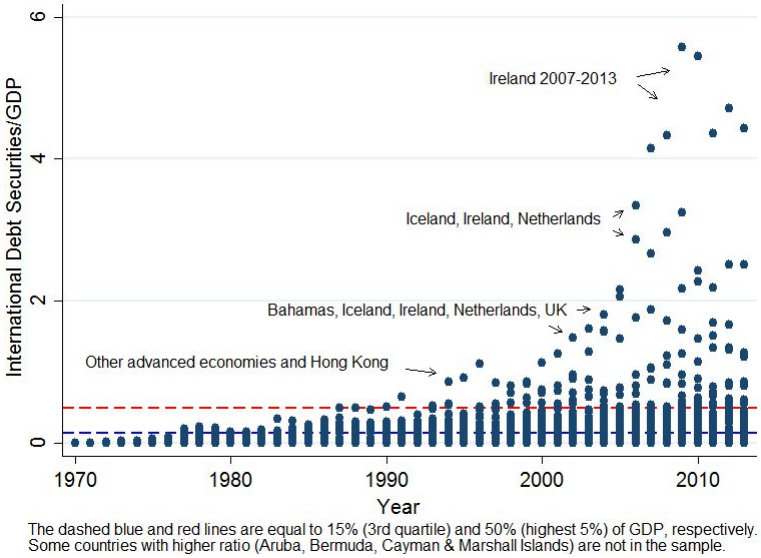


Figure 3.3: The growing influence of Global Investors

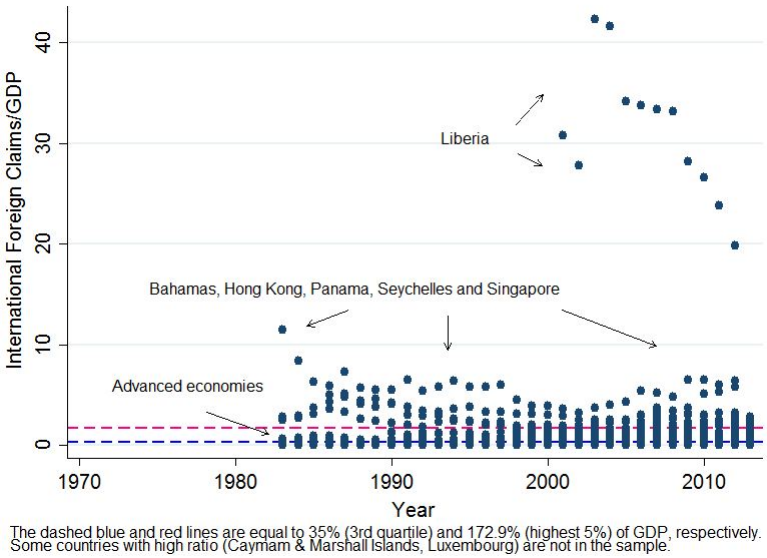


Figure 3.4: The large influence of Global Banks

Inflation Cycles. I account for the correlation of interest rates by controlling for the correlation of monthly consumer price indices between domestic country i and base country j. It is the same methodology as Aizenman et al. (2008) and I define the index of inflation cycle desynchronization as follows

$$DesynchCPI_{it} = 1 - \frac{corr(CPI_{imt}, CPI_{jmt}) + 1}{2} \tag{3.6}$$

The decomposition of the inflation cycle according to open versus closed countries and advanced economies versus the developing world provides a similar trend in the following Figure 3.5.

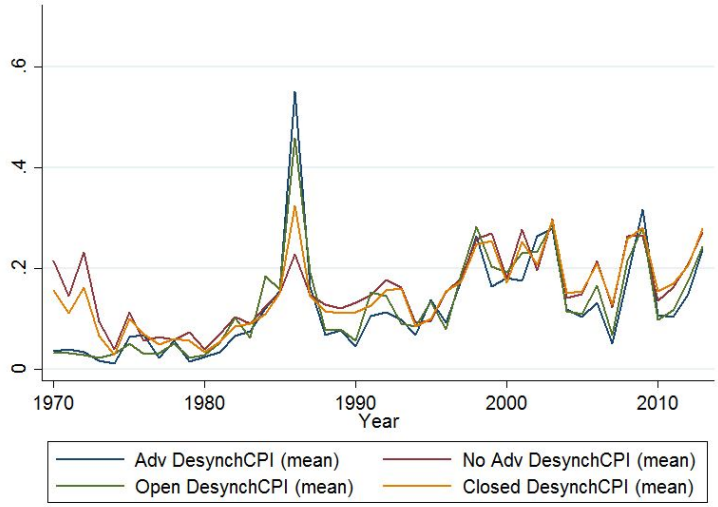


Figure 3.5: Various inflation cycles desynchronization

Does the Global Financial Cycle affect the trend of monetary policy independence?

To ensure the link with monetary policy independence, I analyze the possible comovement between the monetary policy independence de facto index, the VIX, and the presence of global players in domestic economies. Figure 3.6 suggests that the global financial cycle could play a role in the trilemma at least through global banks. At first sight, the negative comovement seems to appear, especially for the VIX and the high presence of global banks in domestic economies. But this worldwide index of monetary policy independence is also driven by general trends in terms of financial openness, the degree of fixity of the exchange rate, and the level of international reserves. In addition, the global financial cycle is a recent phenomenon, especially in emerging and developing countries.

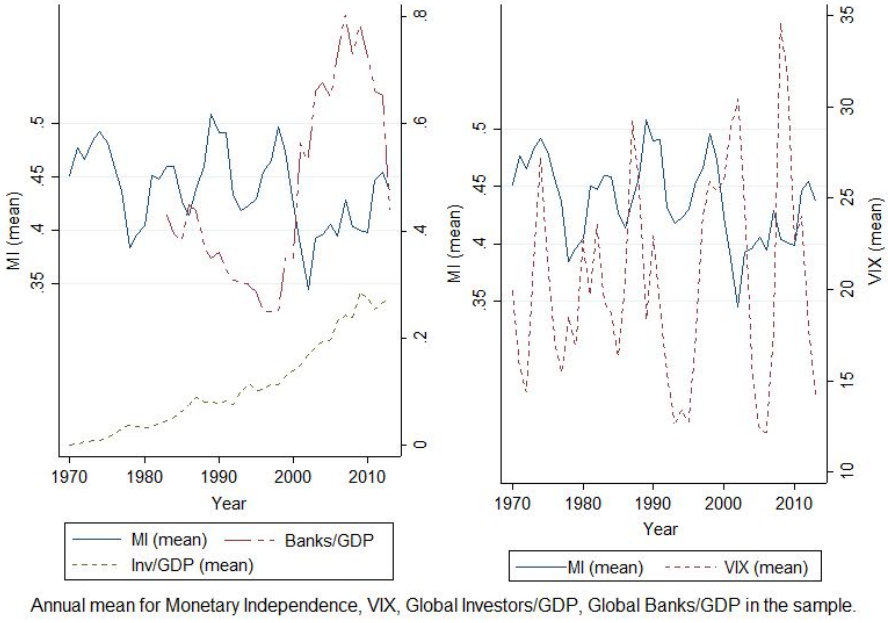


Figure 3.6: Does the Global Financial Cycle affect the trend of monetary policy independence?

3.7 Variables Definition and Multicollinearity Concerns

Tables in the paper suggest multicollinearity and I do not find any effect of timing in trilemma configurations through conditional terms. Thus, I can test the stability of the results with simpler trilemma decision variables, namely *Peg*, *Open*, and the interaction term. Table 3.13 provides the same results as my baseline. The small difference in the coefficient reflecting the worst trilemma case is explained by the three feasible cases of the interaction term, including a shift from closed peg to open peg, a shift from open float to open peg, or a simultaneous shift from closed float to open peg. Table 3.14 investigates the role of global players based on the previous methodology. It sharply restricts multicollinearity problems, even if the *Global Investors* variable appears quite highly correlated to other variables. I find close quantitative results, especially when the domestic country is highly dependent on global players and decides to go to the worst trilemma configuration.

Table 3.13 provides a close specification to the baseline but without conditional terms. Table 3.14 highlights that the results are consistent with multicollinearity troubles and includes mean VIF coefficients.

Table 3.13: Trilemma mechanisms - Sensitivity analysis

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	Monetary Policy Independence Index					
Peg	-0.0395***	-0.0143	-0.0115	-0.00877	-0.00948	-0.00735
	(0.0121)	(0.0102)	(0.0104)	(0.0106)	(0.0104)	(0.0105)
Open	-0.0207	-0.0285**	-0.0120	-0.00682	-0.0111	-0.00668
	(0.0137)	(0.0134)	(0.0142)	(0.0145)	(0.0143)	(0.0146)
Peg x Open	-0.141***	-0.124***	-0.132***	-0.127***	-0.124***	-0.121***
	(0.0255)	(0.0237)	(0.0227)	(0.0220)	(0.0221)	(0.0217)
Int. Res.	0.0641	0.0702	0.101*	0.103*	0.0847	0.0885
	(0.0418)	(0.0514)	(0.0567)	(0.0583)	(0.0556)	(0.0575)
Dom. Fin.	-0.0652***	-0.0860***	-0.0725***	-0.0604***	-0.0548***	-0.0466***
	(0.0150)	(0.0160)	(0.0183)	(0.0178)	(0.0177)	(0.0174)
DesynchCPI	-0.0101	-0.0222*	-0.0101	-0.00987	-0.0116	-0.0112
	(0.0172)	(0.0118)	(0.0124)	(0.0126)	(0.0124)	(0.0126)
VIX (log)	-0.000590	-0.00327				
	(0.0104)	(0.00993)				
Global Investors				-0.0602***		-0.0528***
				(0.0157)		(0.0153)
Global Banks					-0.0527***	-0.0454***
					(0.0130)	(0.0129)
Constant	0.510***	0.521***	0.503***	0.491***	0.500***	0.490***
	(0.0328)	(0.0328)	(0.0201)	(0.0210)	(0.0198)	(0.0208)
Country FE	No	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	Yes	Yes	Yes	Yes
Obs.	4427	4427	4427	4427	4427	4427
Countries	161	161	161	161	161	161
adj. R^2	0.194	0.103	0.142	0.151	0.150	0.156

*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

Robust standard errors in parentheses.

Table 3.14: Multicollinearity concerns - Sensitivity analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.	Monetary Policy Independence Index							
Peg	-0.0803***	-0.0393***	-0.0304***	-0.0245***	-0.0333**	-0.0115	-0.00683	-0.00786
	(0.0124)	(0.00720)	(0.00720)	(0.00732)	(0.0130)	(0.00825)	(0.00821)	(0.00829)
Open	-0.0577***	-0.0442***	-0.0237***	-0.0235***	-0.00353	-0.0133	0.00157	-0.00406
	(0.0133)	(0.00875)	(0.00870)	(0.00895)	(0.0134)	(0.00993)	(0.00993)	(0.0102)
Peg x Open					-0.137***	-0.0967***	-0.0820***	-0.0671***
					(0.0239)	(0.0147)	(0.0151)	(0.0156)
Int. Res.	0.0542	0.108***	0.0715***	0.0723***	0.0632	0.101***	0.0659**	0.0704***
	(0.0441)	(0.0273)	(0.0272)	(0.0271)	(0.0439)	(0.0271)	(0.0270)	(0.0270)
Dom. Fin.	-0.0517***	-0.0619***	-0.0487***	-0.0433***	-0.0461***	-0.0573***	-0.0476***	-0.0409***
	(0.0150)	(0.0101)	(0.0102)	(0.0103)	(0.0122)	(0.0101)	(0.0102)	(0.0103)
DesynchCPI	-0.00404	-0.00307	-0.00663	-0.00677	-0.0116	-0.00829	-0.0114	-0.0107
	(0.0203)	(0.0133)	(0.0132)	(0.0131)	(0.0196)	(0.0132)	(0.0131)	(0.0131)
Global Inv.	-0.0752***	0.000655		-0.0284	-0.0699***	-0.0621***		-0.0799***
	(0.0184)	(0.0178)		(0.0177)	(0.0159)	(0.0210)		(0.0209)
Peg x Inv.		-0.0871***		-0.0480***		0.0397		0.0558*
		(0.0155)		(0.0162)		(0.0288)		(0.0289)
Open x Inv.		-0.0312*		0.0144		0.0330		0.0698***
		(0.0176)		(0.0181)		(0.0230)		(0.0239)
Peg x Open x Inv						-0.120***		-0.110***
						(0.0331)		(0.0341)
Global Banks	-0.0278*		0.0464***	0.0410***	-0.0222*		0.0230	0.0254*
	(0.0146)		(0.0125)	(0.0127)	(0.0127)		(0.0140)	(0.0141)
Peg x Banks			-0.0938***	-0.0785***			-0.0407**	-0.0440**
			(0.0133)	(0.0141)			(0.0199)	(0.0201)
Open x Banks			-0.120***	-0.112***			-0.0886***	-0.0943***
			(0.0140)	(0.0147)			(0.0184)	(0.0194)
Peg x Open x Banks							-0.0504*	-0.0246
							(0.0269)	(0.0281)
Constant	0.533***	0.495***	0.486***	0.487***	0.494***	0.469***	0.463***	0.468***
	(0.0208)	(0.0310)	(0.0304)	(0.0306)	(0.0223)	(0.0308)	(0.0304)	(0.0305)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean VIF	1.87	1.94	1.91	2.02	1.91	2.13	2.05	2.31
Obs.	4427	4427	4427	4427	4427	4427	4427	4427
Countries	161	161	161	161	161	161	161	161
adj. R^2	0.209	0.387	0.401	0.404	0.239	0.398	0.407	0.411

*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

Robust standard errors in parentheses.

3.8 The Exposure to the Global Financial Cycle: Robustness Tests

Key Comments: I provide details on the measures of the exposure to the global financial cycle through global investors and global banks. The results are not driven by specific outliers such as offshore centers around the world. I assess the strength of the results by comparing the *ad hoc* thresholds with new ones. I successively investigate continuous measures for both trilemma policymakers' decisions and the domestic presence of global players by providing various interaction terms and plotting elasticities. They do not substantively bias the baseline estimates.

Outliers of Global Players. Stylized facts from Supplementary Material 3.6.2 confirm the existence of offshore centers around the world. By consequence, the upper tail of the global players' distribution is specific, especially the highest 5^{th} percentile with very high thresholds. Table 3.15 shed light on the upper tail of the global players' distributions. The new dummies are equal to 1 if the continuous measure is higher than its 95^{th} percentile of the distribution. Columns (1) and (3) suggest that these outliers drive monetary policy independence if and only if I consider global investors. But when I compare the two dummies that reflect the 75^{th} and 95^{th} of the distribution, the baseline dummies encompass all available information. Other columns approve that the effects of the presence of both global players on monetary policy independence is not driven by outliers that supports my identification strategy.

Various thresholds of Global Players. The *ad hoc* threshold raises questions about their level. I compare the key results with the first quartile and the median for both global investors and global players in Table 3.16. The presence *per se* of global players affects trilemma trade-offs if their presence is higher than 15% of domestic GDP while I find no effect for a lower threshold. Tables 3.17 and 3.18 investigate interaction terms in cases of more pegged countries and more financially open country, respectively. When I combine the conditional terms, the high presence of the global player and the interaction terms, the amplification effect of this global players is confirmed. Its magnitude goes up with the threshold level for global banks.

Data Assumption. Table 3.19 investigates the effects of conditional terms according to the presence of global investors and global banks. It follows the same approach as Tables 3.3 and 3.4 but without the previous assumption on global players' data. Again I restrict my database to BIS limitations. This table supports the assumption because of small differences between them. This restriction drops 51 countries, especially in the developing world. There is lower information in the data and the number of shifts to peg for open countries presumably shrinks down. It explains the drop of statistical significance of conditional terms *Peg_Open* when there are no global banks. The same argument holds for the level of financial development, namely specific determinant of developing countries. There is mixed evidence about the presence of global investors per se according to previous tables, due to various geographical and time coverages. About interaction terms, there may be a multicollinearity problem for the little differences, but they are consistent with the mechanisms.

Dummies versus continuous measures. This study crucially depends on how global players presence is measured. The sequential use of continuous and dummy variables helps to ensure the reliability of the results. Table 3.20 distinguishes these two kinds of variables for both global players. In the same way, I examine data without the previous assumption about the non-significant presence of global players. The dummies of *Global Players* still remain highly statistically significant that supports the previous proposition: the effect is non-linear and depends on a threshold. Quantitatively, the sensitivities of monetary policy independence to their presence are close to the baseline result.

Continuous Indexes of Trilemma and Elasticities. Table 3.21 studies the role of global players by providing a slightly different angle. I have so far investigated the exchange rate regime and the financial openness policies through dummies and it confirms the baseline results with continuous measures. Remarkably, the set of control variables and policy options follow previous findings. When there are no global players, a marginal increase of the degree of fixity of the exchange rate regime leads to a decrease in monetary policy autonomy. The same holds for financial openness in similar proportions. trilemma is simply more about trade-offs than extreme choices. Columns (1) and (2) indicate that the presence of global players appears to be negatively correlated with the

monetary policy autonomy. The interaction term with the two trilemma policy decision is highly significant, suggesting international pressures from these two combining forces. The comparison with the other columns confirms results from Tables 3.3 and 3.4: the presence per se of global players does not worsen trilemma, but their presence associated with specific policymaker decisions exacerbate these trade-offs. The average effect of a shift to a more pegged exchange rate regime is magnified by both global investors and global banks. By comparison, this amplification effect only occurs for global banks in the case of financial liberalization. It suggests that global investors reinforce transmission channels between the exchange rate regime and monetary policy autonomy but not with the degree of financial openness. Some explanations are conceivable. For instance, the behavior of these two global players could be different in the event of a currency crisis. Global investors are by definition non-resident while the presence of global banks means bank affiliates. On the one hand, global banks have the opportunity to use their informative benefit and profit from local and foreign loanable funds. On the other hand, global investors could suffer from the risk exposure, which in turn might generate a self-fulfilling currency crisis. In line with Table 3.14 and with Goldberg (2013)'s argument, the coefficient of global banks alone is sometimes positive when an interaction is included. This effect only exists for columns (7) to (9) when trilemma decisions interact with the degree of financial openness. It means that the high presence of global banks in relatively financially closed country is positively associated with monetary policy independence. Besides, interaction terms in this table are only average effect and can hide important disparities, including for global investors with financial openness.

To refine and supplement this study, I suppose that effects of trilemma variables are non-linear. Until now, dichotomic variables are used to define the presence of global players and continuous measures will help us to better understand this heterogeneity of roles. I plot variable elasticities at many values of the independent variable by using the previous specification with trilemma continuous terms. Figure A3.7 illustrates that the effect of financial liberalization on monetary policy autonomy is non-linear and increasing as expected. The following two Figures 3.8 and 3.9 are characterized by the presence or not of these global players. Again, the sensitivity to the global financial cycle depends less on the whims of these financial forces than on the presence of global investors and global banks.

The Figure 3.10 investigates the interactions between financial openness and the exchange rate

regime. When there are no global players, the effect of financial liberalization on monetary policy conditions does not depend on the fixity of exchange rate. But when global players have a major impact on the economy, the effect of financial openness seems higher and increases with the degree of pegged exchange rate. In turn, too large interval confidences in non-reported Figures preclude the reciprocal of these conclusions: I cannot say anything about the effect of a shift to a more pegged exchange rate regime according to the level of financial liberalization and the global players. Next, Figure 3.11 extends this approach by using a continuous measure of the presence of global investors that is the ratio of international debt securities to GDP. The results for the continuous measure of global banks are not reported, but there is a purely linear effect according to their economic size. In the same way, I do not report the figure for financial openness because of too large confidence interval but Figure 3.11 relies on the effect of the presence of global investors on the trilemma trade-offs. The increasing confidence interval suggests this heterogeneity of role when their presence is large in comparison to the domestic economy: this phenomenon appears when it exceeds a threshold of 200% of GDP. Finally, Figure 3.12 plots the potential non-linear effect of the role of global investors in the economy, which supports my strategy with successive dummies and continuous measures.

Both Continuous Interaction Terms. One drawback of my analysis is the presence of *ad hoc* thresholds of global players. Even if I motivate this approach, the use of binary variables compresses information. By contrast, Tables 3.22 and 3.23 consider continuous interaction terms. It is the more restrictive view of my dataset and it is another direct test of my data assumption. When there is no global players, a marginal increase *on average* of the degree of exchange rate fixity and of the financial openness still generally decreases room for manoeuvre for monetary policy. About the role of global investors, columns (1) to (3) of Table 3.22 suggest a key role but the specification is probably driven by outliers and specificities of continuous interaction terms. Consequently, columns (4) to (6) drop the main feasible outliers of global investors, global banks and both, respectively. This process removes a very small number of countries and corresponds to my methodology detailed in Table 3.15. It confirms the amplification effect about exchange rate regime but it also suggests the same thing about financial liberalization. However, this last effect is not consistent because the coefficient of financial openness for countries without any global investors becomes significantly

positive. It is hard to correctly interpret these interaction terms. In addition, there is likely not enough variation in terms of financial liberalization process for these specific countries.

Table 3.23 highlights continuous interaction terms for both global players. Columns (4) and (8) confirm that there is no amplification effect of Global Investors on financial openness. The amplification effect of global investors on exchange rate regime is conditional on the absence of the outliers, confirmed by Table 3.22. But the marginal effect of global banks associated with policy shifts suffers from noisy outliers, as suggested by columns (6) to (8). Finally, the comparison between Tables 3.21 and 3.23 provides at least one insight, which is the following: the marginal growing presence of global banks per se or associated with a policy shift has no effect on monetary policy autonomy while a sufficiently high presence of them sharply worsen trilemma's trade-offs.

Table 3.15: Outliers of Global Players - Sensitivity analysis

	(1)	(2)	(3)	(4)	(5)
Dep. Var.	Monetary Policy Independence Index				
Peg_Open	-0.0839***	-0.0789***	-0.0835***	-0.0780***	-0.0740***
	(0.0209)	(0.0211)	(0.0214)	(0.0218)	(0.0215)
Peg_Closed	-0.0104	-0.00813	-0.00961	-0.00777	-0.00671
	(0.0101)	(0.0102)	(0.0102)	(0.0102)	(0.0102)
Open_Peg	-0.0917***	-0.0842***	-0.0926***	-0.0868***	-0.0794***
	(0.0216)	(0.0211)	(0.0220)	(0.0211)	(0.0207)
Open_Float	-0.00834	-0.00329	-0.00871	-0.00801	-0.00322
	(0.0135)	(0.0137)	(0.0135)	(0.0136)	(0.0138)
Int. Res.	0.0910	0.0936	0.0878	0.0739	0.0759
	(0.0556)	(0.0574)	(0.0550)	(0.0540)	(0.0557)
Dom. Fin.	-0.0575***	-0.0497***	-0.0663***	-0.0506***	-0.0361**
	(0.0178)	(0.0175)	(0.0179)	(0.0172)	(0.0171)
DesynchCPI	-0.0115	-0.0110	-0.0109	-0.0122	-0.0129
	(0.0122)	(0.0124)	(0.0125)	(0.0125)	(0.0126)
Global Inv 95%	-0.0611**	-0.0483			-0.0401
	(0.0295)	(0.0295)			(0.0279)
Global Inv 75%		-0.0518***			-0.0473***
		(0.0153)			(0.0148)
Global Banks 95%			-0.0324	-0.0269	-0.0327
			(0.0227)	(0.0237)	(0.0226)
Global Banks 75%				-0.0486***	-0.0398***
				(0.0128)	(0.0124)
Constant	0.514***	0.506***	0.519***	0.517***	0.507***
	(0.0168)	(0.0175)	(0.0165)	(0.0166)	(0.0177)
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Obs.	4427	4427	4427	4427	4427
Countries	161	161	161	161	161
adj. R^2	0.153	0.159	0.150	0.157	0.163

With the Within estimator, Peg_Open means a shift from float to peg given that a country is open.
With the Within estimator, Open_Peg means a shift from closed to open given that a country is pegged.
*, **, and *** respectively denote significance at the 10, 5, and 1% levels.
Robust standard errors in parentheses.

Table 3.16: Various thresholds of Global Players - Sensitivity analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.	Monetary Policy Independence Index							
	Global Investors					Global Banks		
% of GDP	1%	5%	15%	50%	7%	16%	35%	173%
Peg_Open	-0.0845***	-0.0827***	-0.0788***	-0.0839***	-0.0817***	-0.0810***	-0.0786***	-0.0835***
	(0.0214)	(0.0217)	(0.0216)	(0.0209)	(0.0215)	(0.0218)	(0.0218)	(0.0214)
Peg_Closed	-0.00967	-0.00837	-0.00737	-0.0104	-0.0113	-0.0107	-0.00773	-0.00958
	(0.0102)	(0.0102)	(0.0103)	(0.0101)	(0.0101)	(0.0104)	(0.0102)	(0.0102)
Open_Peg	-0.0934***	-0.0914***	-0.0849***	-0.0917***	-0.0924***	-0.0920***	-0.0873***	-0.0926***
	(0.0217)	(0.0216)	(0.0212)	(0.0216)	(0.0216)	(0.0217)	(0.0209)	(0.0220)
Open_Float	-0.00885	-0.00609	-0.00319	-0.00834	-0.00787	-0.00826	-0.00799	-0.00872
	(0.0134)	(0.0135)	(0.0136)	(0.0135)	(0.0133)	(0.0136)	(0.0136)	(0.0135)
Int. Res.	0.0940*	0.0919*	0.0956*	0.0910	0.0832	0.0871	0.0782	0.0879
	(0.0555)	(0.0552)	(0.0569)	(0.0556)	(0.0564)	(0.0554)	(0.0544)	(0.0550)
Dom. Fin.	-0.0691***	-0.0666***	-0.0581***	-0.0575***	-0.0616***	-0.0581***	-0.0527***	-0.0663***
	(0.0179)	(0.0176)	(0.0175)	(0.0178)	(0.0173)	(0.0176)	(0.0174)	(0.0179)
DesynchCPI	-0.0101	-0.0100	-0.00987	-0.0115	-0.0123	-0.0112	-0.0115	-0.0110
	(0.0123)	(0.0124)	(0.0125)	(0.0122)	(0.0124)	(0.0125)	(0.0124)	(0.0125)
Global Pl. 25%	0.00240				-0.0377***			
	(0.0127)				(0.0127)			
Global Pl. 50%		-0.0170				-0.0303**		
		(0.0124)				(0.0120)		
Global Pl. 75%			-0.0557***				-0.0493***	
			(0.0151)				(0.0127)	
Global Pl. 95%				-0.0611**				-0.0325
				(0.0295)				(0.0230)
Constant	0.518***	0.515***	0.508***	0.514***	0.519***	0.518***	0.516***	0.519***
	(0.0165)	(0.0166)	(0.0172)	(0.0168)	(0.0163)	(0.0164)	(0.0166)	(0.0165)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	4427	4427	4427	4427	4427	4427	4427	4427
Countries	161	161	161	161	161	161	161	161
adj. R^2	0.150	0.151	0.157	0.153	0.155	0.153	0.156	0.150

With the Within estimator, Peg_Open means a shift from float to peg given that a country is open.

With the Within estimator, Open_Peg means a shift from closed to open given that a country is pegged.

*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

Robust standard errors in parentheses.

Table 3.17: Interaction terms Between peg decisions and various thresholds - Sensitivity analysis

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	Monetary Policy Independence Index					
Global Pl.	Global Investors			Global Banks		
Threshold	1st quart.	Med.	Third quart.	1st quart.	Med.	Third quart.
% of GDP	1%	5%	15%	7%	16%	35%
Peg_Open	-0.0151	-0.0208	-0.0649***	-0.0135	-0.0271	-0.0400*
	(0.0348)	(0.0282)	(0.0226)	(0.0257)	(0.0253)	(0.0223)
Peg_Closed	-0.00677	-0.00877	-0.00887	-0.00978	-0.0167	-0.00851
	(0.0115)	(0.0109)	(0.0104)	(0.0118)	(0.0109)	(0.0102)
Open_Peg	-0.0926***	-0.0772***	-0.0762***	-0.0835***	-0.0766***	-0.0717***
	(0.0211)	(0.0202)	(0.0206)	(0.0200)	(0.0202)	(0.0201)
Open_Float	-0.0101	-0.00749	-0.00511	-0.0106	-0.00953	-0.0118
	(0.0132)	(0.0133)	(0.0132)	(0.0133)	(0.0133)	(0.0134)
Int. Res.	0.0959*	0.0888	0.0944	0.0760	0.0741	0.0646
	(0.0557)	(0.0555)	(0.0586)	(0.0551)	(0.0540)	(0.0531)
Dom. Fin.	-0.0667***	-0.0618***	-0.0552***	-0.0579***	-0.0540***	-0.0479***
	(0.0179)	(0.0172)	(0.0172)	(0.0176)	(0.0179)	(0.0172)
DesynchCPI	-0.00995	-0.00796	-0.00827	-0.0124	-0.0103	-0.0121
	(0.0125)	(0.0128)	(0.0129)	(0.0124)	(0.0127)	(0.0123)
Global Pl.	0.00993	-0.000246	-0.0377**	-0.0281**	-0.0231*	-0.0205
	(0.0135)	(0.0137)	(0.0181)	(0.0138)	(0.0125)	(0.0141)
Peg_Open x Global Pl.	-0.0884**	-0.118***	-0.0616**	-0.104***	-0.105***	-0.126***
	(0.0375)	(0.0306)	(0.0311)	(0.0212)	(0.0242)	(0.0222)
Peg_Closed x Global Pl.	-0.00815	-0.00212	0.0160	-0.00298	0.0290	0.000795
	(0.0211)	(0.0259)	(0.0354)	(0.0162)	(0.0195)	(0.0218)
Constant	0.484***	0.507***	0.506***	0.486***	0.518***	0.512***
	(0.0176)	(0.0172)	(0.0174)	(0.0174)	(0.0163)	(0.0168)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	4427	4427	4427	4427	4427	4427
Countries	161	161	161	161	161	161
adj. R^2	0.152	0.159	0.160	0.161	0.163	0.168

With the Within estimator, Peg_Open means a shift from float to peg given that a country is open.

With the Within estimator, Open_Peg means a shift from closed to open given that a country is pegged.

*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

Robust standard errors in parentheses.

Table 3.18: Interaction terms between openness decisions and various thresholds - Sensitivity analysis

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	Monetary Policy Independence Index					
Global Pl.	Global Investors			Global Banks		
Threshold	1st quart.	Med.	Third quart.	1st quart.	Med.	Third quart.
% of GDP	1%	5%	15%	7%	16%	35%
Peg_Open	-0.0736***	-0.0721***	-0.0736***	-0.0752***	-0.0699***	-0.0712***
	(0.0218)	(0.0228)	(0.0214)	(0.0219)	(0.0227)	(0.0216)
Peg_Closed	-0.00833	-0.00877	-0.00784	-0.0113	-0.00960	-0.00865
	(0.0103)	(0.0103)	(0.0102)	(0.0103)	(0.0104)	(0.0102)
Open_Peg	-0.0223	-0.0217	-0.0681***	-0.0209	-0.0286	-0.0355
	(0.0315)	(0.0229)	(0.0218)	(0.0216)	(0.0207)	(0.0216)
Open_Float	0.0213	0.000908	-0.00656	0.0245	0.0153	0.00371
	(0.0186)	(0.0184)	(0.0138)	(0.0211)	(0.0177)	(0.0146)
Int. Res.	0.0989*	0.0894	0.0941	0.0779	0.0754	0.0598
	(0.0553)	(0.0553)	(0.0586)	(0.0546)	(0.0528)	(0.0524)
Dom. Fin.	-0.0637***	-0.0617***	-0.0556***	-0.0565***	-0.0523***	-0.0469***
	(0.0175)	(0.0172)	(0.0174)	(0.0174)	(0.0178)	(0.0173)
DesynchCPI	-0.00896	-0.00794	-0.00864	-0.0112	-0.00911	-0.0129
	(0.0124)	(0.0127)	(0.0127)	(0.0124)	(0.0127)	(0.0123)
Global Pl.	0.0172	0.00420	-0.0379	-0.0208	-0.00507	-0.000427
	(0.0128)	(0.0137)	(0.0240)	(0.0132)	(0.0132)	(0.0154)
Open_Peg x Global Pl.	-0.106***	-0.127***	-0.0614*	-0.106***	-0.123***	-0.151***
	(0.0385)	(0.0340)	(0.0353)	(0.0210)	(0.0241)	(0.0221)
Open_Float x Global Pl.	-0.0459**	-0.0178	0.00511	-0.0471**	-0.0501***	-0.0625***
	(0.0216)	(0.0249)	(0.0285)	(0.0193)	(0.0186)	(0.0231)
Constant	0.510***	0.508***	0.507***	0.479***	0.514***	0.512***
	(0.0172)	(0.0172)	(0.0174)	(0.0174)	(0.0166)	(0.0170)
Obs.	4427	4427	4427	4427	4427	4427
Countries	161	161	161	161	161	161
adj. R^2	0.155	0.159	0.159	0.162	0.164	0.171

With the Within estimator, Peg_Open means a shift from float to peg given that a country is open.

With the Within estimator, Open_Peg means a shift from closed to open given that a country is pegged.

*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

Robust standard errors in parentheses.

Table 3.19: Looking for the role of Global Players: Data assumption - Sensitivity analysis

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	Monetary Policy Independence Index					
	Global Investors			Global Banks		
Peg_Open	-0.0532*	-0.0570**	-0.0535*	-0.0149	-0.0591**	-0.0169
	(0.0284)	(0.0277)	(0.0309)	(0.0286)	(0.0279)	(0.0331)
Peg_Closed	-0.0184	-0.0167	-0.0199	-0.00874	-0.0158	-0.00329
	(0.0230)	(0.0220)	(0.0228)	(0.0219)	(0.0220)	(0.0227)
Open_Peg	-0.0846***	-0.0839***	-0.0884***	-0.0782***	-0.0296	-0.0616*
	(0.0275)	(0.0285)	(0.0319)	(0.0249)	(0.0306)	(0.0338)
Open_Float	-0.0165	-0.0216	-0.0226	-0.0206	-0.00151	0.00548
	(0.0182)	(0.0194)	(0.0196)	(0.0185)	(0.0222)	(0.0223)
Int. Res.	0.128	0.127	0.129	0.115	0.103	0.0995
	(0.0811)	(0.0809)	(0.0812)	(0.0768)	(0.0764)	(0.0744)
Dom. Fin.	-0.0237	-0.0236	-0.0237	-0.0176	-0.0188	-0.0171
	(0.0250)	(0.0248)	(0.0248)	(0.0250)	(0.0249)	(0.0245)
DesynchCPI	0.00822	0.00676	0.00749	0.00478	0.00533	0.00484
	(0.0211)	(0.0210)	(0.0211)	(0.0204)	(0.0205)	(0.0204)
Global Player	-0.0457*	-0.0520*	-0.0654*	-0.00221	0.00637	0.0375
	(0.0272)	(0.0279)	(0.0363)	(0.0178)	(0.0251)	(0.0260)
Peg_Open x Global Pl.	-0.0194		-0.0179	-0.111***		-0.120**
	(0.0402)		(0.0728)	(0.0294)		(0.0588)
Peg_Closed x Global Pl.	0.0172		0.0352	-0.0376		-0.0732*
	(0.0484)		(0.0521)	(0.0353)		(0.0387)
Open_Peg x Global Pl.		-0.0108	0.0198		-0.125***	-0.0404
		(0.0404)	(0.0612)		(0.0345)	(0.0518)
Open_Float x Global Pl.		0.0197	0.0307		-0.0538	-0.0835**
		(0.0356)	(0.0396)		(0.0331)	(0.0357)
Constant	0.444***	0.445***	0.446***	0.482***	0.443***	0.439***
	(0.0328)	(0.0327)	(0.0328)	(0.0397)	(0.0337)	(0.0339)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	2216	2216	2216	2216	2216	2216
Countries	110	110	110	110	110	110
adj. R^2	0.114	0.114	0.114	0.120	0.121	0.124

With the Within estimator, Peg_Open means a shift from float to peg given that a country is open.

With the Within estimator, Open_Peg means a shift from closed to open given that a country is pegged.

*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

Robust standard errors in parentheses.

Table 3.20: Dummies versus continuous measures of Global Players - Sensitivity analysis

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	Monetary Policy Independence Index					
Constraint		Yes		Yes		Yes
Peg_Open	-0.0617***	-0.0576**	-0.0802***	-0.0787***	-0.0593**	-0.0543*
	(0.0223)	(0.0229)	(0.0260)	(0.0263)	(0.0272)	(0.0279)
Peg_Closed	-0.0117	-0.00856	-0.0109	-0.01000	-0.0172	-0.0153
	(0.0164)	(0.0167)	(0.0142)	(0.0141)	(0.0216)	(0.0218)
Open_Peg	-0.108***	-0.104***	-0.0744***	-0.0724***	-0.0911***	-0.0845***
	(0.0234)	(0.0227)	(0.0262)	(0.0253)	(0.0292)	(0.0266)
Open_Float	-0.000706	0.00341	-0.0229	-0.0225	-0.0192	-0.0152
	(0.0163)	(0.0164)	(0.0152)	(0.0153)	(0.0185)	(0.0181)
Int. Res.	0.188**	0.185**	0.0589	0.0545	0.132	0.125
	(0.0839)	(0.0822)	(0.0655)	(0.0654)	(0.0801)	(0.0813)
Dom. Fin.	-0.0298	-0.0348*	-0.0511**	-0.0439*	-0.0215	-0.0169
	(0.0227)	(0.0203)	(0.0226)	(0.0224)	(0.0286)	(0.0256)
DesynchCPI	0.00309	0.00194	-0.00960	-0.00994	0.00723	0.00596
	(0.0189)	(0.0192)	(0.0141)	(0.0141)	(0.0209)	(0.0206)
IDS/GDP	-0.0290				-0.0104	
	(0.0219)				(0.0238)	
Global Investors		-0.0487***				-0.0474**
		(0.0155)				(0.0187)
CFC/GDP			-0.00120		-0.00701	
			(0.00831)		(0.00965)	
Global Banks				-0.0251**		-0.0313*
				(0.0126)		(0.0170)
Constant	0.509***	0.501***	0.496***	0.496***	0.446***	0.452***
	(0.0281)	(0.0287)	(0.0256)	(0.0257)	(0.0354)	(0.0338)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	2734	2734	3552	3552	2216	2216
Countries	111	111	158	158	110	110
adj. R^2	0.201	0.206	0.081	0.083	0.107	0.117

With the Within estimator, Peg_Open means a shift from float to peg given that a country is open.
With the Within estimator, Open_Peg means a shift from closed to open given that a country is pegged.
*, **, and *** respectively denote significance at the 10, 5, and 1% levels.
Robust standard errors in parentheses.

Table 3.21: Continuous indexes of Trilemma - Sensitivity analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. Var.	Monetary Policy Independence Index								
ERS	-0.0944***	0.0379*	0.0376*	0.0395*	0.0374*	0.0364	0.0334	0.0346	0.0351
	(0.0218)	(0.0221)	(0.0222)	(0.0220)	(0.0221)	(0.0221)	(0.0215)	(0.0215)	(0.0219)
Kaopen	-0.0857***	0.101***	0.0867***	0.109***	0.0898***	0.0772**	0.117***	0.0984***	0.0888***
	(0.0209)	(0.0306)	(0.0322)	(0.0312)	(0.0326)	(0.0308)	(0.0303)	(0.0305)	(0.0320)
ERS x Kao		-0.313***	-0.294***	-0.324***	-0.290***	-0.282***	-0.293***	-0.260***	-0.242***
		(0.0442)	(0.0486)	(0.0442)	(0.0488)	(0.0453)	(0.0425)	(0.0437)	(0.0472)
Int. Res.	0.0953*	0.0842	0.0934*	0.0959*	0.0930*	0.0729	0.0706	0.0635	0.0660
	(0.0571)	(0.0541)	(0.0554)	(0.0548)	(0.0557)	(0.0512)	(0.0513)	(0.0502)	(0.0525)
Dom. Fin.	-0.0526***	-0.0451***	-0.0568***	-0.0559***	-0.0559***	-0.0530***	-0.0487***	-0.0496***	-0.0447***
	(0.0177)	(0.0163)	(0.0162)	(0.0166)	(0.0163)	(0.0159)	(0.0166)	(0.0162)	(0.0160)
DesynchCPI	-0.00349	-0.0142	-0.0124	-0.0128	-0.0118	-0.0137	-0.0140	-0.0133	-0.0129
	(0.0130)	(0.0124)	(0.0123)	(0.0125)	(0.0125)	(0.0122)	(0.0123)	(0.0123)	(0.0124)
Global Inv.	-0.0500***	-0.0448***	-0.00407	-0.0258	0.0234				-0.0164
	(0.0162)	(0.0139)	(0.0268)	(0.0319)	(0.0416)				(0.0394)
ERS x Inv.			-0.0747*		-0.0758*				-0.0526
			(0.0380)		(0.0385)				(0.0360)
Kao x Inv.				-0.0328	-0.0351				0.0210
				(0.0385)	(0.0382)				(0.0382)
Global Banks	-0.0497***	-0.0383***				0.00803	0.0373*	0.0827***	0.0729**
	(0.0136)	(0.0117)				(0.0230)	(0.0205)	(0.0278)	(0.0280)
ERS x Banks						-0.0865***		-0.0788***	-0.0621**
						(0.0299)		(0.0265)	(0.0271)
Kao x Banks							-0.138***	-0.134***	-0.128***
							(0.0283)	(0.0276)	(0.0293)
Constant	0.580***	0.483***	0.482***	0.480***	0.479***	0.490***	0.480***	0.477***	0.471***
	(0.0275)	(0.0242)	(0.0243)	(0.0243)	(0.0243)	(0.0233)	(0.0234)	(0.0235)	(0.0241)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	4427	4427	4427	4427	4427	4427	4427	4427	4427
Countries	161	161	161	161	161	161	161	161	161
adj. R^2	0.150	0.176	0.174	0.173	0.174	0.175	0.182	0.184	0.187

*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

Robust standard errors in parentheses.

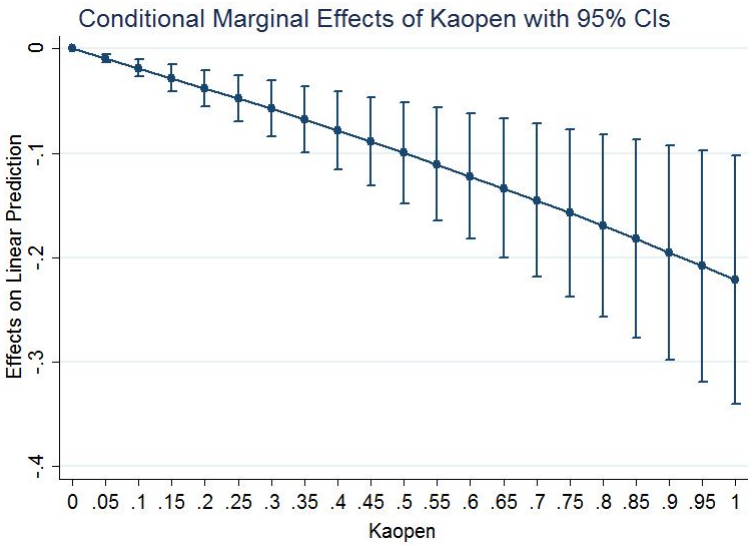


Figure 3.7: The non-linear effect of the financial openness

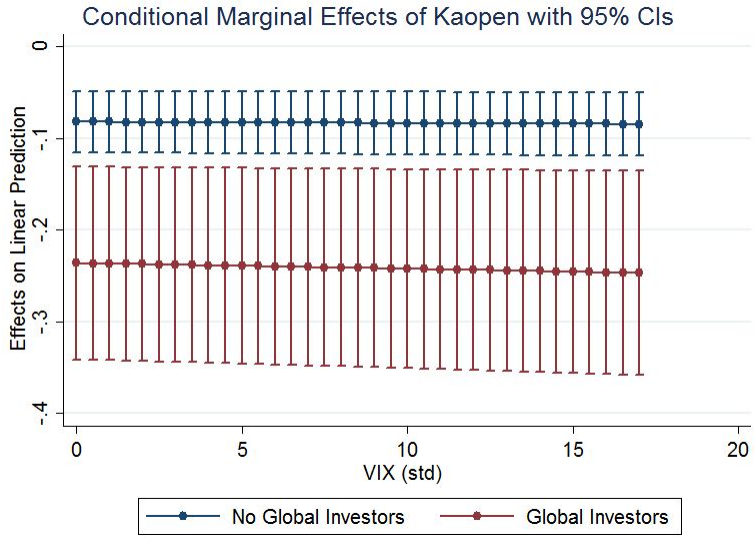


Figure 3.8: Global Investors matter, not the fluctuations of the Global Financial Cycle

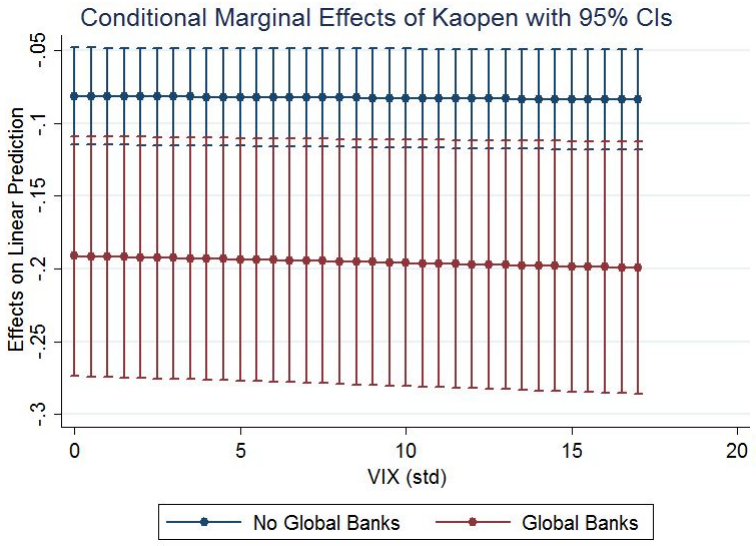


Figure 3.9: Global Banks matter, not the fluctuations of the Global Financial Cycle

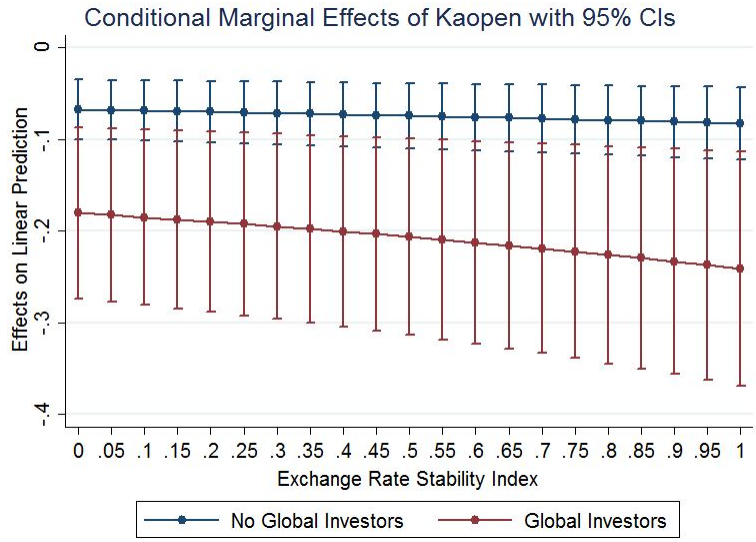


Figure 3.10: The destabilizing role of financial openness according to exchange rate regime and Global Investors

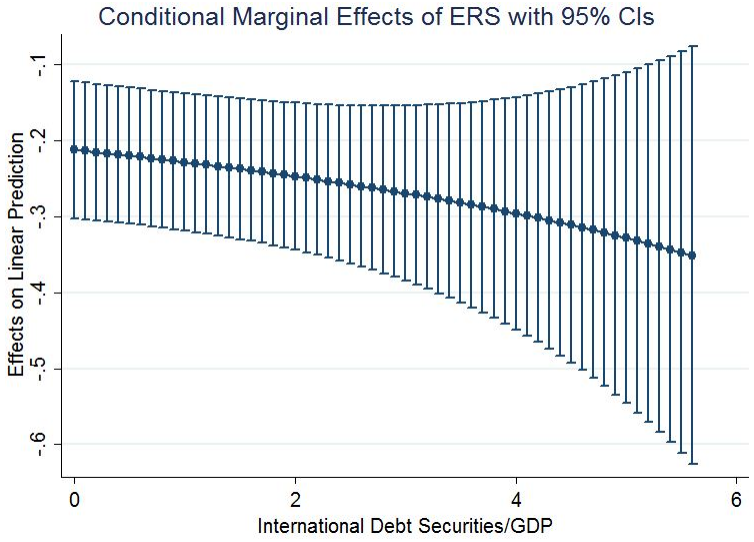


Figure 3.11: The effect of exchange rate regime depends on heterogenous Global Investors

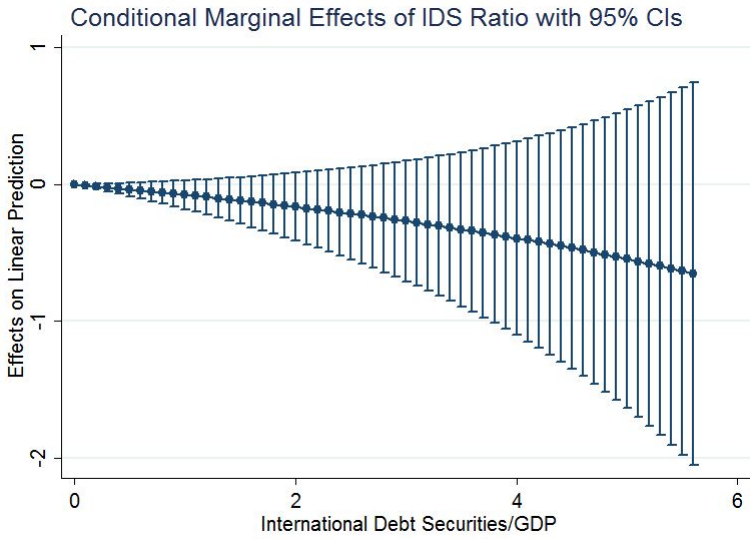


Figure 3.12: The heterogeneous effect of Global Investors

Table 3.22: Interaction terms with continuous measures of Trilemma and of Global Investors

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	Monetary Policy Independence Index					
Drop Outliers 5%				Inv.	Banks	Inv, Banks
ERS	0.0276	0.0268	0.0273	0.0439	0.0308	0.0475
	(0.0368)	(0.0367)	(0.0366)	(0.0368)	(0.0369)	(0.0369)
Kaopen	0.101**	0.121***	0.115***	0.114**	0.128***	0.115**
	(0.0408)	(0.0395)	(0.0425)	(0.0456)	(0.0445)	(0.0473)
ERS x Kao	-0.322***	-0.335***	-0.329***	-0.283***	-0.320***	-0.263***
	(0.0582)	(0.0554)	(0.0579)	(0.0631)	(0.0615)	(0.0659)
Int. Res.	0.162**	0.159**	0.158**	0.108	0.111	0.0620
	(0.0762)	(0.0740)	(0.0742)	(0.0735)	(0.0865)	(0.0824)
Dom. Fin.	-0.0440**	-0.0395*	-0.0415*	-0.0281	-0.0380*	-0.0273
	(0.0208)	(0.0206)	(0.0212)	(0.0222)	(0.0223)	(0.0237)
DesynchCPI	-0.000545	-0.00157	-0.000951	-0.00859	0.00325	-0.00322
	(0.0186)	(0.0185)	(0.0187)	(0.0190)	(0.0196)	(0.0202)
IDS/GDP	0.0496	0.0772	0.0857*	0.329*	0.173**	0.345*
Gl. Investors	(0.0427)	(0.0609)	(0.0491)	(0.185)	(0.0736)	(0.186)
ERS x IDS/GDP	-0.0818*		-0.0318	-0.360**	-0.0486	-0.472***
	(0.0454)		(0.0575)	(0.159)	(0.0870)	(0.168)
Kao x IDS/GDP		-0.110*	-0.0895	-0.310*	-0.240***	-0.325*
		(0.0641)	(0.0822)	(0.175)	(0.0872)	(0.177)
Constant	0.526***	0.518***	0.520***	0.491***	0.507***	0.485***
	(0.0341)	(0.0342)	(0.0347)	(0.0365)	(0.0343)	(0.0365)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	2734	2734	2734	2589	2565	2460
Countries	111	111	111	110	108	107
adj. R^2	0.222	0.223	0.223	0.188	0.220	0.189

*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

Robust standard errors in parentheses.

Table 3.23: Interaction terms with continuous measures of Trilemma and of both Global Players.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.	Monetary Policy Independence Index							
Drop Outliers 5%					Inv.	Banks	I&Bk	I&Bk
ERS	0.0302	0.0301	0.0309	0.0236	0.0331	0.0460*	0.0491*	0.0572
	(0.0264)	(0.0262)	(0.0262)	(0.0389)	(0.0255)	(0.0277)	(0.0274)	(0.0403)
Kaopen	0.0536	0.0634*	0.0606*	0.0443	0.0671*	0.0550	0.0533	0.0253
	(0.0342)	(0.0355)	(0.0353)	(0.0451)	(0.0347)	(0.0390)	(0.0391)	(0.0535)
ERS x Kao	-0.248***	-0.255***	-0.244***	-0.235***	-0.239***	-0.205***	-0.200***	-0.160**
	(0.0524)	(0.0511)	(0.0522)	(0.0619)	(0.0504)	(0.0535)	(0.0511)	(0.0639)
Int. Res.	0.0645	0.0657	0.0640	0.114	0.0345	0.00550	-0.0202	0.00576
	(0.0636)	(0.0632)	(0.0626)	(0.0772)	(0.0603)	(0.0666)	(0.0635)	(0.0829)
Dom. Fin.	-0.0510**	-0.0510**	-0.0515**	-0.0337	-0.0484**	-0.0330	-0.0268	0.00761
	(0.0218)	(0.0216)	(0.0215)	(0.0295)	(0.0238)	(0.0238)	(0.0250)	(0.0324)
DesynchCPI	-0.0117	-0.0120	-0.0118	0.00651	-0.0135	-0.0162	-0.0167	0.00445
	(0.0138)	(0.0138)	(0.0138)	(0.0205)	(0.0137)	(0.0146)	(0.0145)	(0.0219)
CFC/GDP	-0.000455	0.0142	0.0229	-0.0240	0.0293	0.0608	0.0559	0.00189
Gl. Banks	(0.00667)	(0.0292)	(0.0308)	(0.0240)	(0.0300)	(0.0639)	(0.0692)	(0.106)
ERS x CFC/GDP	-0.00793		-0.0118	-0.00377	-0.0110	-0.122**	-0.139**	-0.151*
	(0.0106)		(0.0136)	(0.0101)	(0.0139)	(0.0581)	(0.0662)	(0.0867)
Kao x CFC/GDP		-0.0206	-0.0273	0.0196	-0.0355	-0.0638	-0.0456	0.000457
		(0.0309)	(0.0324)	(0.0276)	(0.0327)	(0.0620)	(0.0692)	(0.0940)
IDS/GDP				0.0859*				0.0920
Gl. Investors				(0.0516)				(0.225)
ERS x IDS/GDP				-0.0785				-0.331*
				(0.0679)				(0.186)
Kao x IDS/GDP				-0.0415				0.0672
				(0.0989)				(0.224)
Constant	0.496***	0.490***	0.491***	0.457***	0.492***	0.478***	0.481***	0.477***
	(0.0305)	(0.0309)	(0.0308)	(0.0429)	(0.0310)	(0.0309)	(0.0316)	(0.0499)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	3552	3552	3552	2216	3409	3374	3271	1944
Countries	158	158	158	110	156	155	153	105
adj. R^2	0.091	0.091	0.092	0.121	0.083	0.086	0.080	0.115

*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

Robust standard errors in parentheses.

3.9 The Fluctuations of the Global Financial Cycle: Robustness Tests

Key Comments: I carefully test the assumptions on the fluctuations of the global financial cycle. I investigate various global factors like the TED spread which could be estimated as a proxy for the global financial cycle. Again, I test other thresholds and extend this analysis by estimating an endogenous threshold. In all cases, the results remain close to the baseline estimates.

Global Variables. I have so far analyzed differences across year fixed effects and a unique global variable. Table 3.24 offers an overview of potential other global variables used in this literature, that is an alternative measure of the VIX, the TED spread and the oil price. Because of the three feasible variables of the VIX, I employ here its standard deviation rather than its annual mean.[18] The TED spread is not directly used in the baseline specification because it begins in 1986. It is the difference between the interest rates on interbank loans and on short-term US government debt. The TED spread reflects the funding conditions for global banks and may be a good proxy of private credit risk perceptions, close to the VIX. As emphasized by Bruno and Shin (2015b), the TED spread is a significant driver of cross-border bank flows. An increase of the TED spread should drop cross-border bank flows, which in turn has an ambiguous effect on monetary policy autonomy. It could be a positive impact through the limited exposure of the future capital flows. The impact of global banks on monetary policy independence is unclear, as suggested by Goldberg (2013). I find significant and positive coefficient of TED spread in opposition to the role of the VIX. Columns (3) and (4) emphasize that the VIX is the main driver of the global financial cycle in line with Miranda-Agrippino and Rey (2015) and Rey (2015) whereas the TED spread covers the rest of year fixed effects. Furthermore, I have tried to combine the VIX and the oil price to catch more year fixed effects but without significant change. Taken together, these tests never change the effect of conditional shifts and of global players on monetary policy autonomy. Finally, I re-examine estimated year fixed effects and their reaction to these global variables. The two-step approach in column (8) confirms the role of this global variables but does not catch a higher part of year fixed effect than the baseline specification.

[18] The three variables provide similar insights.

Various VIX Thresholds. The definition of my *ad hoc* threshold allows testing other possibilities, such as cases of a VIX equal to 17 and 20, namely the first quartile and the medium of the time distribution, respectively. These values are sufficiently high to capture potential non-linearities. Table 3.25 illustrates that the results are robust to other thresholds. The VIX threshold at 17 is sometimes positive because it catches part of all global factors. Because the financial forces are growing over time, I disentangle the time coverage in two sets in Table 3.26. They highlight the increasing trilemma trade-offs in recent years, especially on the shift from closed pegged to open pegged countries and particularly via global players. Again, the low and middle-thresholds capture many global shocks, so it is quite hard to interpret conditional and interaction terms, especially in columns (4) and (6).

Endogenous Thresholds. Furthermore, I estimate an endogenous threshold through Panel Smooth Transition Regression *à la* González et al. (2005) in Tables 3.27 and 3.28. I find VIX thresholds close to my previous approach, from 17 to 21. They also support the key result, because the new regime characterized by this high value of VIX increases trilemma trade-offs, especially on financial openness. This methodology never supports the idea of a dilemma.

Table 3.24: Other global financial variables - Sensitivity analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.	Monetary Policy Independence Index							
Peg_Open	-0.0933***	-0.0939***	-0.0900***	-0.0789***	-0.0868***	-0.0880***	-0.0743***	-0.0746***
	(0.0229)	(0.0228)	(0.0231)	(0.0240)	(0.0212)	(0.0213)	(0.0219)	(0.0219)
Peg_Closed	-0.00565	-0.00584	-0.00550	-0.00247	-0.0103	-0.0108	-0.00703	-0.00603
	(0.0143)	(0.0144)	(0.0142)	(0.0140)	(0.00994)	(0.00990)	(0.00994)	(0.0103)
Open_Peg	-0.0940***	-0.0944***	-0.0902***	-0.0762***	-0.0977***	-0.0968***	-0.0810***	-0.0807***
	(0.0262)	(0.0265)	(0.0260)	(0.0237)	(0.0229)	(0.0230)	(0.0212)	(0.0205)
Open_Float	-0.0195	-0.0201	-0.0128	-0.00653	-0.0210	-0.0207	-0.0108	-0.00325
	(0.0149)	(0.0153)	(0.0148)	(0.0156)	(0.0129)	(0.0129)	(0.0135)	(0.0137)
Int. Res.	0.0793	0.0751	0.114*	0.119*	0.0778	0.0793	0.0797	0.0822
	(0.0603)	(0.0660)	(0.0619)	(0.0619)	(0.0528)	(0.0527)	(0.0531)	(0.0563)
Dom. Fin.	-0.0660***	-0.0674***	-0.0533***	-0.0274	-0.0761***	-0.0755***	-0.0440***	-0.0452***
	(0.0200)	(0.0213)	(0.0196)	(0.0188)	(0.0167)	(0.0167)	(0.0163)	(0.0171)
DesynchCPI	-0.0199	-0.0197	-0.0107	-0.0128	-0.0230*	-0.0206*	-0.0177	-0.0112
	(0.0140)	(0.0140)	(0.0142)	(0.0141)	(0.0120)	(0.0118)	(0.0119)	(0.0126)
TED Spread (mean)	0.0304***	0.0305***	0.0585***	0.0513***				
	(0.00930)	(0.00922)	(0.0121)	(0.0122)				
Oil Price (mean)		0.00318			-0.00949	-0.00710	0.00281	
		(0.0163)			(0.0119)	(0.0122)	(0.0124)	
VIX (std)			-0.00453***	-0.00368***		-0.00116*	-0.000793	
			(0.000915)	(0.000948)		(0.000663)	(0.000668)	
Global Inv.				-0.0507***			-0.0551***	-0.0490***
				(0.0175)			(0.0146)	(0.0148)
Global Banks				-0.0431***			-0.0470***	-0.0427***
				(0.0129)			(0.0125)	(0.0126)
Constant	0.478***	0.475***	0.465***	0.464***	0.517***	0.517***	0.494***	0.508***
	(0.0200)	(0.0249)	(0.0202)	(0.0196)	(0.0168)	(0.0168)	(0.0168)	(0.0174)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	No	No	No	Yes
Second-stage								
TED Spread								0.0308*
Oil Price								-0.0132*
VIX (std)								-0.0029
% of Year FE								0.212
Obs.	3558	3558	3558	3558	4427	4427	4427	4427
Countries	159	159	159	159	161	161	161	161
adj. R^2	0.088	0.088	0.096	0.109	0.111	0.112	0.127	0.162

With the Within estimator, Peg_Open means a shift from float to peg given that a country is open.

With the Within estimator, Open_Peg means a shift from closed to open given that a country is pegged.

*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

Robust standard errors in parentheses.

Table 3.25: Various thresholds of financial stress - Sensitivity analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.	Monetary Policy Independence Index							
Threshold							17	20
Peg_Open	-0.0887***	-0.0875***	-0.0887***	-0.0857***	-0.0887***	-0.0846***	-0.0882***	-0.0719***
	(0.0212)	(0.0209)	(0.0211)	(0.0211)	(0.0211)	(0.0212)	(0.0313)	(0.0242)
Peg_Closed	-0.0108	-0.00896	-0.0106	-0.00957	-0.0109	-0.00904	0.00174	-0.00228
	(0.00992)	(0.0100)	(0.00994)	(0.00997)	(0.00993)	(0.00998)	(0.0126)	(0.0114)
Open_Peg	-0.0978***	-0.0986***	-0.0982***	-0.0981***	-0.0977***	-0.0993***	-0.0900***	-0.100***
	(0.0231)	(0.0229)	(0.0231)	(0.0229)	(0.0230)	(0.0229)	(0.0311)	(0.0288)
Open_Float	-0.0220*	-0.0224*	-0.0225*	-0.0191	-0.0219*	-0.0189	-0.0174	-0.0116
	(0.0127)	(0.0126)	(0.0127)	(0.0125)	(0.0127)	(0.0125)	(0.0165)	(0.0145)
Int. Res.	0.0676	0.0672	0.0676	0.0692	0.0675	0.0704	0.0670	0.0652
	(0.0497)	(0.0499)	(0.0498)	(0.0494)	(0.0497)	(0.0494)	(0.0498)	(0.0497)
Dom. Fin.	-0.0797***	-0.0810***	-0.0802***	-0.0788***	-0.0797***	-0.0790***	-0.0810***	-0.0805***
	(0.0153)	(0.0155)	(0.0153)	(0.0153)	(0.0153)	(0.0154)	(0.0155)	(0.0152)
DesynchCPI	-0.0199*	-0.0260**	-0.0209*	-0.0192*	-0.0200*	-0.0180	-0.0257**	-0.0194
	(0.0116)	(0.0119)	(0.0117)	(0.0116)	(0.0116)	(0.0116)	(0.0119)	(0.0118)
Stress (VIX=23)	-0.00590			-0.0201***	-0.00762	-0.00826		
	(0.00583)			(0.00621)	(0.00734)	(0.00736)		
Stress (VIX=17)		0.0187***		0.0293***		0.0349***	0.0263***	
		(0.00609)		(0.00652)		(0.00670)	(0.00991)	
Stress (VIX=20)			-0.00377		0.00206	-0.0175***		0.0105
			(0.00548)		(0.00680)	(0.00667)		(0.00921)
Peg_Open x St.							0.00135	-0.0391
							(0.0377)	(0.0355)
Peg_Closed x St.							-0.0155	-0.0183
							(0.0122)	(0.0127)
Open_Peg x St.							-0.0125	0.00777
							(0.0364)	(0.0380)
Open_Float x St.							-0.00707	-0.0233
							(0.0166)	(0.0162)
Constant	0.508***	0.494***	0.508***	0.491***	0.508***	0.490***	0.488***	0.502***
	(0.0132)	(0.0141)	(0.0133)	(0.0141)	(0.0133)	(0.0140)	(0.0155)	(0.0138)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	No	No	No	No
Obs.	4427	4427	4427	4427	4427	4427	4427	4427
Countries	161	161	161	161	161	161	161	161
adj. R^2	0.111	0.114	0.111	0.117	0.111	0.117	0.113	0.112

With the Within estimator, Peg_Open means a shift from float to peg given that a country is open.

With the Within estimator, Open_Peg means a shift from closed to open given that a country is pegged.

*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

Robust standard errors in parentheses.

Table 3.26: Financial forces over time - Sensitivity analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.	Monetary Policy Independence Index							
Coverage	96-2013	70-95		96-2013			70-95	
Threshold	23	23	17	20	23	17	20	23
Peg_Open	-0.0781**	-0.0185	-0.0662	-0.0322	-0.0363	-0.0682**	-0.0288	-0.0231
	(0.0331)	(0.0265)	(0.0587)	(0.0436)	(0.0417)	(0.0282)	(0.0300)	(0.0265)
Peg_Closed	-0.0203	-0.0147	0.0160	0.0165	0.00370	-0.0173	-0.0182	-0.0162
	(0.0193)	(0.0127)	(0.0328)	(0.0240)	(0.0221)	(0.0147)	(0.0142)	(0.0131)
Open_Peg	-0.0760**	-0.0297	-0.0837	-0.0991**	-0.0954**	0.0134	-0.00720	-0.0170
	(0.0320)	(0.0262)	(0.0523)	(0.0441)	(0.0415)	(0.0262)	(0.0283)	(0.0272)
Open_Float	-0.0451*	-0.00778	-0.0394	-0.0189	-0.0236	-0.0188	-0.00757	-0.00414
	(0.0251)	(0.0228)	(0.0389)	(0.0313)	(0.0294)	(0.0234)	(0.0253)	(0.0239)
Int. Res.	0.100	0.0195	0.106*	0.109*	0.108*	0.0448	0.0331	0.0312
	(0.0620)	(0.0962)	(0.0621)	(0.0604)	(0.0606)	(0.0956)	(0.0962)	(0.0963)
Dom. Fin.	-0.0585**	-0.0273	-0.0559**	-0.0370	-0.0375	-0.0195	-0.0117	-0.0131
	(0.0248)	(0.0343)	(0.0251)	(0.0247)	(0.0246)	(0.0333)	(0.0350)	(0.0353)
DesynchCPI	0.0100	-0.0566***	0.00695	0.0110	0.00983	-0.0597***	-0.0563***	-0.0540***
	(0.0168)	(0.0160)	(0.0163)	(0.0164)	(0.0166)	(0.0161)	(0.0163)	(0.0164)
Global Investors				-0.0438**	-0.0430**		-0.0428*	-0.0431
				(0.0204)	(0.0204)		(0.0251)	(0.0262)
Global Banks				-0.0436***	-0.0440***		0.000218	0.00131
				(0.0162)	(0.0161)		(0.0314)	(0.0314)
Stress	-0.00537	0.00262	0.0228	0.0156	0.0120	0.0216**	0.00100	-0.00759
	(0.00814)	(0.00699)	(0.0253)	(0.0169)	(0.0148)	(0.00935)	(0.00829)	(0.00910)
Peg_Open x St.			-0.00961	-0.0875*	-0.0902*	0.103***	0.0560	0.138***
			(0.0617)	(0.0520)	(0.0530)	(0.0385)	(0.0343)	(0.0293)
Peg_Closed x St.			-0.0441	-0.0542**	-0.0348*	0.00476	0.0121	0.0149
			(0.0319)	(0.0237)	(0.0210)	(0.0158)	(0.0130)	(0.0150)
Open_Peg x St.			0.0142	0.0777	0.0808	-0.0761**	-0.0597	-0.118***
			(0.0604)	(0.0539)	(0.0541)	(0.0317)	(0.0378)	(0.0356)
Open_Float x St.			-0.00362	-0.0326	-0.0259	0.0353**	0.0320	0.0408
			(0.0318)	(0.0245)	(0.0216)	(0.0173)	(0.0236)	(0.0255)
Constant	0.488***	0.475***	0.463***	0.478***	0.481***	0.453***	0.467***	0.469***
	(0.0234)	(0.0222)	(0.0338)	(0.0253)	(0.0243)	(0.0231)	(0.0224)	(0.0224)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	No	No	No	No
Obs.	2529	1898	2529	2529	2529	1898	1898	1898
Countries	159	124	159	159	159	124	124	124
adj. R^2	0.034	0.008	0.036	0.049	0.046	0.024	0.013	0.012

With the Within estimator, Peg_Open means a shift from float to peg given that a country is open.

With the Within estimator, Open_Peg means a shift from closed to open given that a country is pegged.

*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

Robust standard errors in parentheses.

3.9.1 Endogenous Thresholds

This paper demonstrates that the stance of the trilemma becomes more uncertain. The path is doubtfully non-linear. I employ thresholds but the previous specification is not designed to perfectly include continuous indexes and to endogenously provide thresholds. I propose using Panel Smooth Transition Regression by González et al. (2005). This specification transforms the sample into various regimes with their own coefficient for each of them. This distribution is cut-off through transition variable. In other words, non-linearity is characterized as a function of an observable variable. This model endogenously provides the optimal number of regimes, the threshold(s) and the speed of the transition. In line with the potential move from trilemma to dilemma, I analyze two regimes, namely *Trilemma* and *Dilemma* and I adopt the VIX as transition variable. The specification becomes:

$$MI_{it} = \beta_0\ ERS_{it} + \beta_1\ ERS_{it} \times g(VIX_t, \gamma, c) + \beta_2\ Kaopen_{it} + \beta_3\ Int.Res._{it} + \mu_i + \epsilon_{it} \quad (3.7)$$

The transition function is a continuous function of the observable transition variable VIX_t[19] and is normalized from 0 to 1. It is defined by González et al. (2005), among others, as follows:

$$g(VIX_t, \gamma, c) = (1 + exp(-\gamma \prod_{j=1}^{m}(VIX_t - c_j)))^{-1} \quad (3.8)$$

The parameter $\gamma > 0$ reflects the smoothness of the transition(s). The thresholds[20] are defined in the vector $c = (c_1, ...c_m)$ and respect $\gamma > 0, c_1 < ... < c_m$. According to González et al. (2005), set m equal to 1 or 2 is generally sufficient to capture all non-linearities. When m is equal to 1, this function transition reflects a logistic function and the two regimes are characterized by different dynamics. These extreme values are associated with coefficients β_0 and $\beta_0 + \beta_1$. This β_1 represents the slope of the change between these two regimes and so this statistical significance is the key to prove the dilemma. When m is equal to 2, this transition function transforms into a quadratic logistic function. In this case, β_0 is the coefficient associated with the two extreme cases in this distribution and $\beta_0 + \beta_1$ is the value of the mean of the VIX.

Nonetheless, this specification is subject to criticism, because I only interact transition function

[19] The VIX is country-invariant but it does not change properties of the PSTR.
[20] They are called location parameters in this literature.

with the exchange rate regime in order to test the dilemma. But it is straightforward to think that the international financial pressures also magnify the impact of financial openness. As robustness check, I interact this transition function with the exchange rate regime and the financial openness. The quadratic logistic function would not appear designed for this debate but it could be useful if I use a continuum of exchange rate regimes. You may have critical effects with extreme exchange rate regimes or with intermediate regimes *à la* Fischer (2001). Before estimating the PSTR model, there is a test on the non-linearity. The previous section points out convincing empirical evidence of non-linearity but this homogeneity test also help to choose between $m = 1$ (logistic function) and $m = 2$ (quadratic logistic function). It tests the null hypothesis $H_0 : \beta_1 = 0$ or its equivalent $H_0 : \gamma = 0$. It is not a standard test because of the presence of nuisance parameters which are unidentified under both null hypothesis[21]. For instance, there is no location parameter c under linearity hypothesis.

The process is quite simple: I test the linearity ($m = 0$) against non-linearity with one threshold ($m = 1$). If linearity is rejected, I test non-linearity with one threshold against two thresholds ($m = 2$) until I find the optimal number of thresholds. I simultaneously choose the optimal transition function. The table 3.27 reports the homogeneity test according to the two possible transition function.

The non-linearities are significant for every specification and for all every specific function transition. The other tests are not reported but the best specification is a double thresholds model ($r = 2$) for every case. Following Couharde and Generoso (2015), I minimize the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) in order to find the best value of m. These criteria are perhaps surprisingly very close, so I adopt the specification close to the test of trilemma against dilemma. A logistic function will make the direct interpretation of β_1 easier.

The table 3.28 highlights the estimates of these three specifications. The columns (1) and (2) consider non-linearity only on financial openness, (3) and (4) on the exchange rate regime and (5) and (6) both. For each specification, the first column gives the results for coefficients β_0, i.e. below the threshold and the second for $\beta_0 + \beta_1$, i.e. over the threshold. I also provide β_1 and its statistical

[21] This test uses first-order Taylor expansion of transition function around $\gamma = 0$. More details on González et al. (2005) or on Couharde and Generoso (2015).

Table 3.27: Homogeneity tests

	Financial openness subject to non-linearity	
	m=1	m=2
LM test	5.967	13.16
	(0.01457)	(0.00139)
Pseudo LRT test	5.97	13.20
	(0.0145)	(0.00136)
	Exchange rate subject to non-linearity	
	m=1	m=2
LM test	4.80	17.70
	(0.028)	$(1.43.10^{-4})$
Pseudo LRT test	4.80	17.77
	(0.028)	$(1.38.10^{-4})$
	Exchange rate and financial openness subject to non-linearity	
	m=1	m=2
LM test	6.3478	18.56
	(0.04)	$(9.57.10^{-4})$
Pseudo LRT test	6.357	18.64
	(0.04)	$(9.24.10^{-4})$

significance in order to examine the slope of the change between these two regimes.

These estimates emphasize the large role of non-linearities, especially on financial openness. The double thresholds are consistent with my previous analysis. The smooth parameters γ are relatively high that indicates a sharp transition between the two regimes. But the β_1 in column (4) is at odds with the idea of dilemma. The negative β_1 for both trilemma variables means that trilemma is worsened by the financial globalization. The column (6) emphasizes the key role of financial openness in this mechanism.

Table 3.28: PSTR estimates

Non-linearity	Kaopen		Exchange Rate Regime		Kaopen and Exchange Rate	
	(1)	(2)	(3)	(4)	(5)	(6)
	β_0	$\beta_0 + \beta_1$	β_0	$\beta_0 + \beta_1$	β_0	$\beta_0 + \beta_1$
ERS	-0.138***	-0.138***	-0.051**	-0.149**	-0.116***	-0.116***
	(0.000)	(0.000)	(0.0013)	(0.0013)	(0.000)	(0.000)
Kaopen	-0.097***	-0.203***	-0.189***	-0.189***	-0.111***	-0.120***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
IR	0.1157***	0.1157***	0.1132***	0.1132***	0.1177***	0.1177***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.007)	(0.007)
β_1 ERS				-0.098***		-0.02
				(0.000)		(0.18)
β_1 Kaopen		-0.106***				-0.09***
		(0.000)				(0.000)
Smooth Parameter	25.46		37.73		25.98	
Location Parameters	[17.74; 21.05]		[17.77; 19.56]		[17.74; 21.05]	
Obs.	2200	2200	2200	2200	2200	2200
Countries	50	50	50	50	50	50

Dependent variable is the Monetary Policy Independence index.

*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

Standard errors in parentheses.

3.10 Is It Really Monetary Policy Autonomy? Other Monetary Condition Variables

Key Comments: I test multiple measures for the correlation of GDP and inflation cycles. I also investigate an alternative definition of monetary policy independence in which the correlations whether positive or negative is a sign of dependence. I ensure that the results imply effective monetary policy independence.

Controlling for GDP Cycles. Klein and Shambaugh (2015) add Taylor rules in their specification to prove that interest rate differentials really mean autonomy. They use the first difference of interest rate differential between a country and a base country as dependent variable. They add the economic growth and the first difference of inflation of the country in a robustness check to demonstrate that it does not change their results about trilemma. I control the correlation of interest rates with the correlation of business cycles and of inflation in a similar manner. Ideally, I should use the annual correlation between monthly or quarterly production and inflation between the domestic country i and the base country j but this kind of data does not exist for production

according to my time and geographical coverage. I employ the correlation of monthly consumer price indexes with the same methodology outlined in Aizenman et al. (2008). For comparison, the index of inflation synchronization and of GDP synchronization are defined as follows:

$$Sync\ Infl_{it} = \frac{|\Delta Infl_{it} + \Delta Infl_{jt}|}{|\Delta Infl_{it}| + |\Delta Infl_{jt}|} \tag{3.9}$$

$$Sync\ GDP_{it} = \frac{|\Delta GDP_{it} + \Delta GDP_{jt}|}{|\Delta GDP_{it}| + |\Delta GDP_{jt}|} \tag{3.10}$$

where ΔGDP_{it} represents the real annual growth rate and $\Delta Infl_{it}$ is the first difference of annual inflation rate. By construction, this kind of measure is normalized and equal to 1 if the two countries follow the same inflation or business cycle. This index is also equal to one if the growth is equal to 0 but it never happens in the data. The synchronization of cycles of the two countries leads to an increase of this measure and should generate some positive comovement of policy interest rates, which in turn reduces monetary policy independence. I can simultaneously employ my first index of the inflation cycle desynchronization with monthly consumer price indexes (CPI), the second with the first difference of annual inflation rate and the third with the first difference of GDP growth. The data coverage does not perfectly match for two reasons. Monthly CPI does not exist in some cases. Besides, this database begins with the first year of monthly CPI and so the first difference of annual inflation rate is unavailable.

The additional control variables in Table 3.29 do not change at all the findings. In addition, the VIX is always strongly significant. By contrast, my inflation index with annual data or with monthly data[22] never affects monetary policy autonomy. Finally, this table suggests that this index related to GDP cycles is always statistically relevant. Perhaps surprisingly, the coefficient is positive while monetary policy independence and GDP cycles synchronization seem contrary. But the mean of this variable *SyncGDP* is equal to 0.834, close to 1 and generally reflects positive growth. Yet, positive GDP growth for these two countries allows more room for monetary policy manoeuvre than

[22]The index of inflation cycle desynchronization with monthly data is negative at a high level of statistical significance if and only if there are no year fixed effects. It is explained by a worldwide monetary policy movement in favor of disinflation policies. As mentioned above, the year 1986 reflects a high increase of inflation desynchronization and a drop of monetary policy independence in open economies. The disinflation policies were trending upwards with partial and heterogeneous results at this time.

GDP growth mismatch. This index imperfectly reflects upward or downward slope, but again, the results are consistent.

Table 3.30 investigates potential shifts with the addition of both inflation and GDP control variables. It confirms the results about conditional terms according to the presence of global investors and global banks. The same ranking of shifts and the same role for the VIX hold.

Alternative Monetary Policy Independence Measure. The monetary policy independence is defined as the ability of countries to set their interest rates. The baseline dependent variable analyzes the absence of correlation or a negative correlation as a sign of monetary policy independence. But a potential other interpretation links monetary policy dependence and correlations, whether positive or negative, which in turn provides the following alternative dependent variable

$$\widetilde{MI_{it}} = \mid corr(i_{imt}, i_{jmt}) \mid \tag{3.11}$$

By contrast with the baseline dependent variable, 0 means here independence and higher values of this index mean more monetary policy dependence. The average value is 0.292 for the sample and the standard deviation is quite high (0.260). Going into more detail, over 57.4 percent (2541) observations provide a positive correlation, while 32.7 percent (1446) of the observations yield a negative correlation.[23] These heterogeneous responses of the domestic policy rate to foreign base country rate clearly fit Ricchi and Shi (2016)'s argument. Table 3.31 replicates the baseline empirical strategy with this alternative dependent variable. Again, the domestic exposure to global players worsens the trilemma. My results are overall unaffected by this alternative specification, but there is one difference: the role of exchange rate regime on monetary policy autonomy disappears in the baseline specification. Similarly, the shift from float to peg has no effect in column (3) when the domestic exposure to global players is low. This runs against to the accepted trilemma mechanisms before the existence of the global financial cycle (Shambaugh, 2004; Obstfeld et al., 2005; Aizenman et al., 2008).

It is therefore likely that positive and negative correlations do not have the same meaning. A positive correlation should reflect a high pass-through from the interest rate for the base country,

[23] Because of constant interest rates, over 9.9 percent (440) of the observations artificially reflect a complete decorrelation.

whereas a negative correlation could be explained by various channels. Three arguments emerge from Ricchi and Shi (2016), namely (i) the central bank mandate, (ii) the willingness to tolerate large swings in the exchange rate (*fear of floating*) and (iii) the degree of synchronization of business cycles. Indeed, the central bank may have different priorities in terms of domestic/foreign objectives and of inflation/unemployment trade-off. Consequently, Table 3.32 differentiates positive and negative correlation. When I focus on the positive correlation in the first four columns, the move to peg for open countries generally reduces the monetary policy independence and the high presence of global players magnifies this mechanism. Yet, the opposite case with negative correlation provides insignificant coefficients. Besides, Klein and Shambaugh (2015) find a significant and positive coefficient on all their subsamples, including for their closed non-peg subsample. It means that an increase in the base interest rate is associated with an increase in the domestic interest rate, whatever the choice of financial openness and of exchange rate regime. These various arguments support my baseline definition of monetary policy independence.

Effective Monetary Policy Independence. The comovement of interest rates appears a good proxy of monetary policy independence but Rey (2015) and Rey (2016) distinguish monetary policy instruments and results because I cannot credibly say that all monetary policy channels go through the short-term interest rate. She uses credit volumes, house prices and equity indices as other proxies of monetary policy autonomy whereas Borio (2014) and Drehmann et al. (2012) analyze them as proxies of national financial cycles. Tables 3.33, 3.34 and 3.35 replicate this strategy by using the dependent variable of the base country as an explanatory variable. This alternative approach could reflect effective monetary policy autonomy because they are determinants of these national financial cycles.

I employ dummies and conditional dummies for trilemma configuration in Tables 3.33 and 3.34 while Table 3.35 extends to continuous measures of financial openness and exchange rate regime. But there is no monthly data of these financial variables to closely follow the baseline specification. The financial variable of the base country is generally irrelevant, probably because of this data frequency. The VIX explains a large share of year fixed effects. This process fits better with financial variables as dependent variable than comovement of policy short-term interest rates. The former reflects more the investors' appetite for risk than the latter, which is subject to policy

decisions.

This approach complements the trilemma-dilemma debate. On the one hand, the presence of global players positively affects the financial variable, with the notable exception of global investors on equity markets at a very low level of statistical significance.[24] On the other hand, trilemma decisions have some impact. Financial openness pushes up equity prices and credit with cross-border flow supply. But the effect of exchange rate regime is quite unclear: my conditional trilemma variables in Table 3.33 suggest no role whereas simple dummies or continuous measures provide other mixed results. Table 3.34 highlights that the move to the worst trilemma configuration is associated with a high drop in equity indices. According to Table 3.35, a marginal increase of the degree of fixity of the exchange rate regime leads to an increase in house prices in monetary policy autonomy. This unlinear and mixed evidence about exchange rate regime is not sufficient to validate the Rey (2015) hypothesis on this effective monetary policy independence. But again, when respectively comparing the first and second columns for each dependent variable in Tables 3.33, 3.34 and 3.35, this effect is mainly driven by global players.

[24] I could argue that these international debt issues allow for international portfolio rather than domestic investment on national assets. It could also be driven by sample effect.

Table 3.29: Is there really autonomy? - Sensitivity analysis with year fixed effects

	(1)	(2)	(3)	(4)	(5)
Dep. Var.	Monetary Policy Independence Index				
Peg_Open	-0.0843***	-0.0870***	-0.0841***	-0.0863***	-0.0834***
	(0.0214)	(0.0215)	(0.0216)	(0.0216)	(0.0215)
Peg_Closed	-0.00959	-0.0105	-0.00772	-0.00811	-0.00720
	(0.0102)	(0.0103)	(0.0102)	(0.0102)	(0.0101)
Open_Peg	-0.0934***	-0.0942***	-0.0938***	-0.0949***	-0.0941***
	(0.0218)	(0.0219)	(0.0217)	(0.0218)	(0.0217)
Open_Float	-0.00870	-0.00984	-0.00896	-0.00980	-0.00853
	(0.0134)	(0.0134)	(0.0134)	(0.0134)	(0.0134)
Int. Res.	0.0933*	0.0983*	0.0921	0.0980*	0.0929*
	(0.0552)	(0.0552)	(0.0559)	(0.0559)	(0.0559)
Dom. Fin.	-0.0690***	-0.0651***	-0.0679***	-0.0639***	-0.0679***
	(0.0179)	(0.0180)	(0.0182)	(0.0183)	(0.0182)
DesynchCPI	-0.0101				-0.0117
	(0.0123)				(0.0123)
Sync_Infl		-0.00631		-0.00679	
		(0.00794)		(0.00795)	
Sync_GDP			0.0219**	0.0229**	0.0220**
			(0.00990)	(0.00999)	(0.00987)
Constant	0.518***	0.520***	0.493***	0.496***	0.494***
	(0.0165)	(0.0177)	(0.0199)	(0.0210)	(0.0199)
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Second-stage					
VIX(log)	-0.0078***	-0.0078***	-0.0070***	-0.0069***	-0.0069***
% of Year FE	0.307	0.302	0.257	0.244	0.25
Obs.	4427	4385	4400	4358	4400
Countries	161	160	161	160	161
adj. R^2	0.150	0.152	0.152	0.154	0.152

Samples with *Sync_Infl* or *Sync_GDP* are restricted to DesynchCPI data.

*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

Robust standard errors in parentheses.

Table 3.30: Looking for the role of Global Players: Other variables - Sensitivity analysis

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	Monetary Policy Independence Index					
	Global Investors			Global Banks		
Peg_Open	-0.0642***	-0.0729***	-0.0666***	-0.0383*	-0.0701***	-0.0476**
	(0.0227)	(0.0216)	(0.0229)	(0.0224)	(0.0217)	(0.0227)
Peg_Closed	-0.00632	-0.00538	-0.00660	-0.00597	-0.00613	-0.00249
	(0.0103)	(0.0101)	(0.0103)	(0.0101)	(0.0102)	(0.0102)
Open_Peg	-0.0770***	-0.0689***	-0.0748***	-0.0722***	-0.0352	-0.0536**
	(0.0206)	(0.0217)	(0.0228)	(0.0202)	(0.0217)	(0.0226)
Open_Float	-0.00493	-0.00603	-0.00636	-0.0116	0.00466	0.00686
	(0.0132)	(0.0138)	(0.0140)	(0.0134)	(0.0146)	(0.0148)
Int. Res.	0.0941	0.0939	0.0943	0.0627	0.0575	0.0584
	(0.0593)	(0.0593)	(0.0593)	(0.0539)	(0.0532)	(0.0533)
Dom. Fin.	-0.0543***	-0.0547***	-0.0545***	-0.0475***	-0.0463***	-0.0457***
	(0.0175)	(0.0176)	(0.0176)	(0.0174)	(0.0175)	(0.0174)
DesynchCPI	-0.00994	-0.0103	-0.00999	-0.0142	-0.0150	-0.0141
	(0.0128)	(0.0127)	(0.0128)	(0.0122)	(0.0123)	(0.0123)
Sync_GDP	0.0197**	0.0196**	0.0197**	0.0194**	0.0223**	0.0225**
	(0.00978)	(0.00979)	(0.00980)	(0.00978)	(0.00955)	(0.00959)
Global Player	-0.0373**	-0.0370	-0.0438	-0.0202	0.00118	0.0220
	(0.0183)	(0.0239)	(0.0303)	(0.0141)	(0.0154)	(0.0193)
Peg_Open x Global Pl.	-0.0608*		-0.0406	-0.128***		-0.102**
	(0.0313)		(0.0490)	(0.0224)		(0.0505)
Peg_Closed x Global Pl.	0.0146		0.0208	0.000785		-0.0402
	(0.0351)		(0.0392)	(0.0216)		(0.0251)
Open_Peg x Global Pl.		-0.0609*	-0.0144		-0.155***	-0.0770
		(0.0353)	(0.0411)		(0.0224)	(0.0468)
Open_Float x Global Pl.		0.00358	0.00948		-0.0660***	-0.0865***
		(0.0285)	(0.0332)		(0.0233)	(0.0270)
Constant	0.485***	0.485***	0.486***	0.491***	0.488***	0.485***
	(0.0207)	(0.0207)	(0.0207)	(0.0202)	(0.0204)	(0.0206)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Second-stage						
VIX(log)	-0.0051***	-0.0051***	-0.0052***	-0.00627***	-0.0070***	-0.0068***
% of Year FE	0.163	0.162	0.163	0.234	0.277	0.263
Obs.	4400	4400	4400	4400	4400	4400
Countries	161	161	161	161	161	161
adj. R^2	0.161	0.161	0.161	0.170	0.174	0.175

With the Within estimator, Peg_Open means a shift from float to peg given that a country is open.
With the Within estimator, Open_Peg means a shift from closed to open given that a country is pegged.
Samples with *Sync_Infl* or *Sync_GDP* are restricted to DesynchCPI data.
*, **, and *** respectively denote significance at the 10, 5, and 1% levels.
Robust standard errors in parentheses.

Table 3.31: Alternative monetary policy independence measure - Sensitivity analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep. Var.			$\widehat{MI}_{it} = \mid corr(i_{imt}, i_{jmt}) \mid$				
	Baseline		Global Investors			Global Banks	
Peg_Open	0.0596	0.00556	0.0354	0.0164	-0.0244	0.0330	0.0111
	(0.0375)	(0.0371)	(0.0359)	(0.0362)	(0.0377)	(0.0354)	(0.0381)
Peg_Closed	0.00514	0.00611	0.00416	0.00653	0.00253	0.00419	0.00111
	(0.0158)	(0.0156)	(0.0155)	(0.0156)	(0.0160)	(0.0155)	(0.0161)
Open_Peg	0.171***	0.131***	0.102***	0.119***	0.132***	0.0683*	0.0864**
	(0.0364)	(0.0332)	(0.0342)	(0.0347)	(0.0333)	(0.0365)	(0.0387)
Open_Float	-0.0205	-0.0194	-0.0171	-0.0168	-0.0134	-0.0192	-0.0211
	(0.0200)	(0.0184)	(0.0186)	(0.0187)	(0.0187)	(0.0199)	(0.0199)
Int. Res.	-0.209***	-0.207**	-0.207**	-0.207**	-0.161**	-0.154**	-0.155**
	(0.0781)	(0.0874)	(0.0876)	(0.0876)	(0.0760)	(0.0752)	(0.0759)
Dom. Fin.	0.0604**	0.0382	0.0386	0.0381	0.0279	0.0277	0.0272
	(0.0300)	(0.0274)	(0.0275)	(0.0275)	(0.0298)	(0.0299)	(0.0296)
DesynchCPI	-0.00858	-0.0140	-0.0131	-0.0138	-0.00545	-0.00373	-0.00453
	(0.0209)	(0.0216)	(0.0215)	(0.0215)	(0.0202)	(0.0201)	(0.0202)
Global Player		-0.000369	0.000627	0.0104	0.00919	0.00859	-0.00942
		(0.0196)	(0.0294)	(0.0392)	(0.0207)	(0.0214)	(0.0248)
Peg_Open x Global Pl.		0.214***		0.128	0.250***		0.0981
		(0.0507)		(0.0873)	(0.0388)		(0.0658)
Peg_Closed x Global Pl.		-0.0284		-0.0389	0.0149		0.0341
		(0.0433)		(0.0542)	(0.0339)		(0.0364)
Open_Peg x Global Pl.			0.215***	0.0799		0.263***	0.187***
			(0.0556)	(0.0794)		(0.0382)	(0.0638)
Open_Float x Global Pl.			-0.00896	-0.0170		0.0145	0.0324
			(0.0338)	(0.0422)		(0.0318)	(0.0338)
Constant	0.0812**	0.1000***	0.0994***	0.0993***	0.0927***	0.0904***	0.0929***
	(0.0327)	(0.0322)	(0.0320)	(0.0321)	(0.0315)	(0.0309)	(0.0312)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	4427	4427	4427	4427	4427	4427	4427
Countries	161	161	161	161	161	161	161
adj. R^2	0.196	0.216	0.215	0.216	0.223	0.224	0.225

With the Within estimator, Peg_Open means a shift from float to peg given that a country is open.

With the Within estimator, Open_Peg means a shift from closed to open given that a country is pegged.

Dependent variable: Alternative Monetary Policy Independence Index.

*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

Robust standard errors in parentheses.

Table 3.32: Alternative monetary policy independence measure - Sensitivity analysis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var.				$\widetilde{MI}_{it} =\mid corr(i_{imt}, i_{jmt}) \mid$				
		$corr(i_{imt}, i_{jmt}) > 0$				$corr(i_{imt}, i_{jmt}) < 0$		
Peg_Open	0.0950**	0.0767*	0.0281	0.00681	-0.0592	-0.0590	-0.0633	-0.0633
	(0.0424)	(0.0427)	(0.0435)	(0.0433)	(0.0430)	(0.0435)	(0.0445)	(0.0458)
Peg_Closed	0.00849	0.00325	0.0117	0.00727	0.0139	0.0152	0.0179	0.0159
	(0.0210)	(0.0210)	(0.0210)	(0.0210)	(0.0202)	(0.0203)	(0.0207)	(0.0210)
Open_Peg	0.175***	0.157***	0.132***	0.134***	-0.00436	-0.00223	-0.00921	-0.00685
	(0.0409)	(0.0375)	(0.0362)	(0.0371)	(0.0426)	(0.0428)	(0.0431)	(0.0414)
Open_Float	-0.0158	-0.0222	-0.0138	-0.0148	0.00129	0.00273	0.00218	0.00276
	(0.0251)	(0.0246)	(0.0226)	(0.0231)	(0.0224)	(0.0221)	(0.0222)	(0.0222)
Int. Res.	-0.271***	-0.244***	-0.242**	-0.213**	0.0377	0.0384	0.0376	0.0377
	(0.0944)	(0.0930)	(0.0951)	(0.0889)	(0.0796)	(0.0799)	(0.0795)	(0.0797)
Dom. Fin.	0.0738**	0.0375	0.0299	0.0321	-0.0686***	-0.0598**	-0.0617**	-0.0590**
	(0.0348)	(0.0342)	(0.0323)	(0.0349)	(0.0251)	(0.0249)	(0.0250)	(0.0252)
DesynchCPI	-0.0274	-0.0246	-0.0326	-0.0259	-0.0258	-0.0268	-0.0269	-0.0259
	(0.0270)	(0.0260)	(0.0266)	(0.0259)	(0.0366)	(0.0370)	(0.0370)	(0.0370)
Global Inv.		0.0640**	0.00102	0.0548**		-0.0165	-0.0157	-0.0147
		(0.0251)	(0.0263)	(0.0243)		(0.0302)	(0.0358)	(0.0309)
Global Banks		0.0776***	0.0719***	0.0112		-0.0189	-0.0183	-0.0195
		(0.0246)	(0.0234)	(0.0269)		(0.0231)	(0.0234)	(0.0280)
Peg_Open x Gl. Inv.			0.188***				0.0396	
			(0.0482)				(0.0766)	
Peg_Closed x Gl. Inv.			-0.0576				-0.0627	
			(0.0449)				(0.0463)	
Peg_Open x Gl. Banks				0.214***				0.0372
				(0.0413)				(0.0589)
Peg_Open x Gl. Banks				0.00592				-0.0124
				(0.0502)				(0.0417)
Constant	0.166***	0.185***	0.196***	0.192***	0.398***	0.397***	0.399***	0.397***
	(0.0402)	(0.0410)	(0.0425)	(0.0432)	(0.0685)	(0.0683)	(0.0687)	(0.0684)
Obs.	2541	2541	2541	2541	1446	1446	1446	1446
Countries	156	156	156	156	154	154	154	154
adj. R^2	0.266	0.280	0.295	0.298	0.044	0.044	0.043	0.043

With the Within estimator, Peg_Open means a shift from float to peg given that a country is open.

With the Within estimator, Open_Peg means a shift from closed to open given that a country is pegged.

Dependent variable: Alternative Monetary Policy Independence Index.

*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

Robust standard errors in parentheses.

Table 3.33: Effective monetary policy autonomy - Sensitivity analysis

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.:	Private Credit		House Prices		Equity Index	
Base_Variable	-0.112	-0.0724	-0.202	-0.119	-0.0904	-0.0370
	(0.0695)	(0.0596)	(0.208)	(0.196)	(0.136)	(0.134)
Peg_Open	0.0692**	0.0359	0.0239	0.0316	0.0336	0.0405
	(0.0318)	(0.0287)	(0.0254)	(0.0254)	(0.0502)	(0.0482)
Peg_Closed	0.0404*	0.0285	0.0268	0.0307	0.108	0.120*
	(0.0218)	(0.0200)	(0.0322)	(0.0320)	(0.0655)	(0.0676)
Open_Peg	0.120***	0.0796**	0.0185	0.0145	-0.0369	-0.0153
	(0.0383)	(0.0328)	(0.0246)	(0.0224)	(0.0389)	(0.0369)
Open_Float	0.0735**	0.0591**	0.0336*	0.0416**	0.102*	0.107**
	(0.0300)	(0.0256)	(0.0186)	(0.0178)	(0.0537)	(0.0534)
Int. Res.	-0.341***	-0.232**	-0.0816	0.00365	0.119	0.0314
	(0.112)	(0.105)	(0.131)	(0.113)	(0.206)	(0.190)
DesynchCPI	-0.0138	-0.00984	-0.0616*	-0.0402	-0.0180	-0.0285
	(0.0195)	(0.0187)	(0.0346)	(0.0302)	(0.0684)	(0.0713)
Global Inv.		0.0970**		-0.0496**		-0.104*
		(0.0381)		(0.0193)		(0.0560)
Global Banks		0.182***		0.104***		-0.0814
		(0.0318)		(0.0364)		(0.0685)
Constant	0.306***	0.270***	2.126***	1.945***	3.477***	3.398***
	(0.0600)	(0.0534)	(0.419)	(0.393)	(0.499)	(0.494)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Second-stage						
VIX(log)	0.0774***	0.0599***	0.0377***	0.0377***	-0.2864***	-0.2966***
% of Year FE	0.641	0.663	0.559	0.559	0.699	0.695
Obs.	4416	4416	1184	1184	1703	1703
Countries	161	161	56	56	67	67
adj. R^2	0.363	0.426	0.413	0.449	0.617	0.622

With the Within estimator, Peg_Open means a shift from float to peg given that a country is open.
With the Within estimator, Open_Peg means a shift from closed to open given that a country is pegged.
*, **, and *** respectively denote significance at the 10, 5, and 1% levels.
Robust standard errors in parentheses.

Table 3.34: Effective monetary policy autonomy - Sensitivity analysis

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.:	Private Credit		House Prices		Equity Index	
Base_Variable	-0.116*	-0.0743	-0.200	-0.115	-0.0845	-0.0311
	(0.0699)	(0.0597)	(0.206)	(0.195)	(0.133)	(0.131)
Peg	0.0451**	0.0321	0.0323	0.0378	0.108	0.120*
	(0.0228)	(0.0209)	(0.0316)	(0.0313)	(0.0647)	(0.0667)
Open	0.0762**	0.0620**	0.0412**	0.0497**	0.105*	0.110*
	(0.0306)	(0.0260)	(0.0205)	(0.0197)	(0.0563)	(0.0565)
Peg x Open	0.0484	0.0102	-0.0255	-0.0348	-0.189**	-0.181**
	(0.0560)	(0.0511)	(0.0521)	(0.0444)	(0.0776)	(0.0762)
Int. Res.	-0.350***	-0.236**	-0.0812	0.00521	0.142	0.0468
	(0.113)	(0.106)	(0.130)	(0.111)	(0.208)	(0.192)
DesynchCPI	-0.0143	-0.0104	-0.0624*	-0.0408	-0.0153	-0.0268
	(0.0198)	(0.0189)	(0.0342)	(0.0296)	(0.0686)	(0.0717)
Global Inv.		0.101***		-0.0500**		-0.104*
		(0.0382)		(0.0192)		(0.0564)
Global Banks		0.183***		0.105***		-0.0846
		(0.0324)		(0.0361)		(0.0681)
Constant	0.266***	0.238***	2.122***	1.936***	3.440***	3.366***
	(0.0595)	(0.0527)	(0.415)	(0.391)	(0.488)	(0.485)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Second-stage						
VIX(log)	0.0924***	0.0707***	0.0362***	0.0316***	-0.2836***	-0.2948***
% of Year FE	0.712	0.731	0.541	0.600	0.699	0.694
Obs.	4416	4416	1184	1184	1703	1703
Countries	161	161	56	56	67	67
adj. R^2	0.359	0.425	0.415	0.452	0.616	0.622

*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

Robust standard errors in parentheses.

Table 3.35: Effective monetary policy autonomy - Sensitivity analysis

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.:	Private Credit		House Prices		Equity Index	
Base_Variable	-0.128*	-0.0799	-0.153	-0.0795	-0.0820	-0.0304
	(0.0697)	(0.0599)	(0.197)	(0.185)	(0.119)	(0.120)
ERS	0.0872**	0.0490	0.0987**	0.0894*	-0.0539	-0.0166
	(0.0388)	(0.0344)	(0.0474)	(0.0481)	(0.0669)	(0.0678)
Kaopen	0.137***	0.0901**	0.00695	0.0238	0.223**	0.227**
	(0.0458)	(0.0376)	(0.0467)	(0.0462)	(0.0994)	(0.0992)
Int. Res.	-0.363***	-0.244**	-0.0533	0.0285	0.199	0.102
	(0.117)	(0.107)	(0.130)	(0.112)	(0.219)	(0.202)
DesynchCPI	-0.0151	-0.00952	-0.0622*	-0.0417	-0.00487	-0.0161
	(0.0194)	(0.0187)	(0.0344)	(0.0296)	(0.0722)	(0.0758)
Global Inv.		0.0998***		-0.0496**		-0.0992*
		(0.0380)		(0.0191)		(0.0573)
Global Banks		0.184***		0.0973***		-0.0941
		(0.0327)		(0.0357)		(0.0700)
Constant	0.217***	0.213***	2.008***	1.842***	3.328***	3.252***
	(0.0596)	(0.0541)	(0.407)	(0.376)	(0.435)	(0.441)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Second-stage						
VIX(log)	0.0924***	0.0698***	0.0334***	0.0298***	-0.2683***	-0.2813***
% of Year FE	0.703	0.720	0.516	0.579	0.702	0.698
Obs.	4416	4416	1184	1184	1703	1703
Countries	161	161	56	56	67	67
adj. R^2	0.358	0.424	0.424	0.457	0.618	0.624

ERS and Kaopen are continuous measures of exchange rate regime and financial openness, respectively.
*, **, and *** respectively denote significance at the 10, 5, and 1% levels.
Robust standard errors in parentheses.

3.11 Other Robustness Tests

Key Comments: Country size and various types of financial crises do not change the main result. They also reflect the potential heterogenous role of global banks *à la* Goldberg (2013), notably because of differences between advanced economies and the emerging world.

Does Size Matter? I am looking for other determinants of trilemma. The domestic financial system and goals of central banks depend on the level of development. Country's size matters for at least two reasons. First, countries do not have the same financial vulnerability with respect to global financial cycle. Second, a sovereign monetary policy is costly for small countries. Consequently, smaller countries are more prone to peg their currencies. Tables 3.36 and 3.37 control the country's sensitivity to financial forces in two ways. The size of the country does not appear as a good determinant but it could be driven by other control variables. I also discriminate countries according to their level of development. This indicates substantial heterogeneity across countries. Table 3.36 shows conditional terms through thresholds while Table 3.37 provides continuous measures. The coefficients of conditional terms are different across groups of countries because of historical trend. In line with Klein (2012), the shift to financial liberalization for pegged countries is generally specific to highly developed countries, as suggested by column (2) in Table 3.36. Table 3.37 goes into more detail about trilemma trade-off with continuous measures. The richest countries are generally more sensitive to trilemma's trade-offs, probably because of their financial linkages. A marginal increase of financial openness is determinant only for no-OECD countries because many OECD countries are open in the 1970s. The high presence of global investors plays a role in richest countries and in lower middle countries whereas the high presence of global banks seems to have a small stabilizing role in poorest countries. The high role of global players only in advanced economies is probably due to the long time coverage, as highlighted by Hofmann and Takàts (2015). The loss of statistical significance compared to column (1) is likely explained by the few observations.

Controlling for Financial Crises. In addition, financial crises are generally associated with massive changes in exchange rates and this monetary policy independence index only reflects emergency situation. Table 3.38 controls for various kinds of financial crises. Laeven and Valencia (2012)

provide us all systemic banking, currency and sovereign debt crises as year dummies. In the first three columns, I investigate these crises as additional control variables of the baseline specification. Only systemic banking crisis are statistically significant but it does not affect the results. In the last three columns, I examine the relationship between these crises and my baseline specification. The high presence of global investors is positively correlated to the possibility of all kinds of financial crises. This broad exposure to the global financial cycle fuels domestic credit in line with Schularick and Taylor (2012). About trilemma trade-offs, currency crises are logically associated to the shift to high pegged currency notably because of the relatively high number of one-year pegged countries, following di Giovanni and Shambaugh (2008). This CPI cycle desynchronization measure is statistically significant with a negative coefficient in the case of currency crises. It seems at odds with the traditional mechanism of currency crises trough currencies divergences but it raises reverse causality issues. When I lag these CPI cycle desynchronization measure (as unreported results), the coefficient becomes statistically significant and positive. It confirms a lagged correlation between these CPI cycles and comovement in policy interest rates, probably due to inflation forecast changes or monetary policy effectiveness.

Reverse Causality. Table 3.39 investigates reverse causality risk: the stance of monetary policy is perhaps a determinant of financial openness and exchange rate regime. Following Aizenman and Ito (2014) and Aizenman et al. (2016), I use lagged explanatory variables. They provide the same story as Tables 3.3 and 3.4, the only difference is the significant coefficient of *Open* conditional on floating exchange rate, but it is statistically significant at 10% level. Finally, Table 3.40 analyzes the baseline specification with lead variables, but without any major changes. It supports a circular relationship between interest rates and trilemma policy decisions, namely exchange rate regime and financial openness.

Table 3.36: Does size matter? - Sensitivity analysis

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	Monetary Policy Independence Index					
Income Group		High, OECD	High, No OECD	Upper middle	Lower middle	Low
Peg_Open	-0.0747***	-0.0245	-0.0867**	-0.103*	-0.0558*	0.0790
	(0.0220)	(0.0360)	(0.0358)	(0.0612)	(0.0324)	(0.0617)
Peg_Closed	-0.00618	-0.0126	0.0231	-0.0138	0.00204	-0.00199
	(0.0103)	(0.0241)	(0.0522)	(0.0278)	(0.0161)	(0.0192)
Open_Peg	-0.0808***	-0.139***	-0.0350	-0.00357	0.0212	-0.0955**
	(0.0206)	(0.0308)	(0.0410)	(0.0474)	(0.0278)	(0.0361)
Open_Float	-0.00351	0.0182	-0.00773	0.00506	0.000578	-0.0778
	(0.0137)	(0.0233)	(0.0477)	(0.0247)	(0.0223)	(0.0562)
Int. Res.	0.0819	0.563***	0.108	-0.0408	0.0705	-0.279
	(0.0563)	(0.155)	(0.0845)	(0.0914)	(0.148)	(0.187)
Dom. Fin.	-0.0452***	-0.0353*	-0.0956	-0.00385	-0.0573	-0.0784**
	(0.0172)	(0.0200)	(0.0577)	(0.0530)	(0.0526)	(0.0375)
DesynchCPI	-0.0111	-0.0193	-0.0366	-0.0156	0.0115	-0.0632**
	(0.0126)	(0.0458)	(0.0312)	(0.0291)	(0.0273)	(0.0236)
Global Inv.	-0.0489***	-0.0504*	0.0449	-0.0404	-0.0668***	-0.0289
	(0.0148)	(0.0250)	(0.0273)	(0.0262)	(0.0207)	(0.0662)
Global Banks	-0.0427***	-0.00954	-0.00988	-0.0249	-0.0387	0.164***
	(0.0127)	(0.0240)	(0.0436)	(0.0206)	(0.0286)	(0.0335)
Country Size	0.00524					
	(0.0369)					
Constant	0.460***	0.372***	0.473***	0.594***	0.496***	0.557***
	(0.123)	(0.0732)	(0.0385)	(0.0445)	(0.0357)	(0.0451)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	4426	1041	524	1090	1119	653
Countries	161	30	21	42	43	25
adj. R^2	0.162	0.438	0.201	0.043	0.082	0.122

With the Within estimator, Peg_Open means a shift from float to peg given that a country is open.

With the Within estimator, Open_Peg means a shift from closed to open given that a country is pegged.

*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

Robust standard errors in parentheses.

Table 3.37: Does size matter? - Sensitivity analysis

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	Monetary Policy Independence Index					
Income Group		High, OECD	High, No OECD	Upper middle	Lower middle	Low
ERS	-0.0953***	-0.295***	-0.202***	-0.0274	-0.00494	0.0485
	(0.0220)	(0.0278)	(0.0502)	(0.0442)	(0.0280)	(0.0288)
Kaopen	-0.0881***	-0.0579	-0.119***	-0.0461	-0.0215	-0.0827
	(0.0214)	(0.0398)	(0.0341)	(0.0374)	(0.0423)	(0.0489)
Int. Res.	0.0938	0.474***	0.0795	-0.0520	0.0787	-0.238
	(0.0573)	(0.144)	(0.0790)	(0.0930)	(0.150)	(0.193)
Dom. Fin.	-0.0528***	-0.0602**	-0.0706	-0.0110	-0.0534	-0.0798*
	(0.0178)	(0.0219)	(0.0506)	(0.0538)	(0.0518)	(0.0414)
DesynchCPI	-0.00333	-0.0125	-0.0473	-0.0226	0.0116	-0.0677**
	(0.0130)	(0.0441)	(0.0303)	(0.0289)	(0.0275)	(0.0266)
Global Inv.	-0.0496***	-0.0534**	0.0492	-0.0320	-0.0719***	-0.0306
	(0.0162)	(0.0236)	(0.0321)	(0.0313)	(0.0190)	(0.0583)
Global Banks	-0.0491***	-0.0139	-0.00916	-0.0254	-0.0395	0.154***
	(0.0137)	(0.0208)	(0.0356)	(0.0229)	(0.0283)	(0.0335)
Country Size	0.0244					
	(0.0353)					
Constant	0.502***	0.598***	0.708***	0.537***	0.502***	0.532***
	(0.116)	(0.0804)	(0.0406)	(0.0651)	(0.0447)	(0.0452)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	4426	1041	524	1090	1119	653
Countries	161	30	21	42	43	25
adj. R^2	0.150	0.459	0.216	0.036	0.082	0.128

*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

Robust standard errors in parentheses.

Table 3.38: Controlling for financial crises - Sensitivity analysis

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	MI	MI	MI	BankingCrisis	CurrencyCrisis	DebtCrisis
Peg_Open	-0.0706***	-0.0700***	-0.0703***	-0.0147*	-0.0205**	0.00108
	(0.0226)	(0.0226)	(0.0226)	(0.00830)	(0.00833)	(0.00418)
Peg_Closed	-0.00401	-0.00345	-0.00377	-0.0117	-0.0237***	-0.00144
	(0.00998)	(0.00997)	(0.00996)	(0.00739)	(0.00869)	(0.00434)
Open_Peg	-0.0832***	-0.0830***	-0.0832***	0.000744	-0.0123	-0.00338
	(0.0205)	(0.0205)	(0.0206)	(0.00657)	(0.00768)	(0.00442)
Open_Float	0.000823	0.00152	0.00137	-0.0246***	-0.0127	0.00402
	(0.0140)	(0.0140)	(0.0140)	(0.00909)	(0.0105)	(0.00412)
Int. Res.	0.0798	0.0809	0.0805	-0.0383	-0.0251	-0.0246
	(0.0540)	(0.0539)	(0.0540)	(0.0247)	(0.0207)	(0.0152)
Dom. Fin.	-0.0438**	-0.0453**	-0.0448**	0.0498***	0.0316***	0.00968
	(0.0177)	(0.0177)	(0.0176)	(0.0112)	(0.0100)	(0.00657)
DesynchCPI	-0.00488	-0.00394	-0.00460	-0.0117	-0.0521***	0.00536
	(0.0132)	(0.0133)	(0.0133)	(0.0108)	(0.0117)	(0.0112)
Global Inv.	-0.0486***	-0.0493***	-0.0490***	0.0236**	0.0171**	0.0120*
	(0.0150)	(0.0150)	(0.0150)	(0.00976)	(0.00795)	(0.00657)
Global Banks	-0.0411***	-0.0416***	-0.0413***	0.0111	0.0173*	0.0115
	(0.0126)	(0.0126)	(0.0126)	(0.00881)	(0.00938)	(0.00710)
BankingCrisis	-0.0216*					
	(0.0130)					
CurrencyCrisis		0.0130				
		(0.0137)				
DebtCrisis			-0.00422			
			(0.0232)			
Constant	0.506***	0.506***	0.506***	0.000499	0.0184**	0.00143
	(0.0176)	(0.0176)	(0.0177)	(0.00695)	(0.00706)	(0.00530)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	4317	4317	4317	4317	4317	4317
Countries	161	161	161	161	161	161
adj. R^2	0.163	0.162	0.162	0.048	0.040	0.019

*, **, and *** respectively denote significance at the 10, 5, and 1% levels.

Robust standard errors in parentheses.

Table 3.39: Endogeneity issues - Sensitivity analysis

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	Monetary Policy Independence Index					
	Global Investors			Global Banks		
L.Peg_Open	-0.0731***	-0.0815***	-0.0773***	-0.0524**	-0.0791***	-0.0635**
	(0.0260)	(0.0248)	(0.0262)	(0.0265)	(0.0246)	(0.0271)
L.Peg_Closed	-0.0137	-0.0120	-0.0144	-0.0122	-0.0122	-0.00928
	(0.0108)	(0.0107)	(0.0108)	(0.0107)	(0.0106)	(0.0107)
L.Open_Peg	-0.0830***	-0.0751***	-0.0794***	-0.0784***	-0.0460**	-0.0585***
	(0.0200)	(0.0216)	(0.0220)	(0.0206)	(0.0208)	(0.0216)
L.Open_Float	-0.0220*	-0.0244*	-0.0254*	-0.0274**	-0.0135	-0.0119
	(0.0129)	(0.0135)	(0.0136)	(0.0125)	(0.0141)	(0.0142)
L.Int. Res.	0.0781	0.0772	0.0785	0.0462	0.0409	0.0417
	(0.0632)	(0.0634)	(0.0633)	(0.0564)	(0.0560)	(0.0562)
L.Dom. Fin.	-0.0476**	-0.0484**	-0.0480**	-0.0410**	-0.0401*	-0.0397*
	(0.0198)	(0.0198)	(0.0198)	(0.0203)	(0.0205)	(0.0204)
L.DesynchCPI	-0.00885	-0.00926	-0.00890	-0.0141	-0.0142	-0.0139
	(0.0135)	(0.0133)	(0.0134)	(0.0127)	(0.0128)	(0.0128)
L.Global Player	-0.0457**	-0.0445*	-0.0611*	-0.0263**	-0.00627	0.00949
	(0.0183)	(0.0239)	(0.0340)	(0.0133)	(0.0156)	(0.0176)
L.Peg_Open x Global Pl.	-0.0569*		-0.0198	-0.114***		-0.0736
	(0.0326)		(0.0649)	(0.0239)		(0.0565)
L.Peg_Closed x Global Pl.	0.0280		0.0425	0.00326		-0.0319
	(0.0336)		(0.0420)	(0.0224)		(0.0247)
L.Open_Peg x Global Pl.		-0.0589	-0.0228		-0.141***	-0.0856
		(0.0370)	(0.0589)		(0.0239)	(0.0528)
L.Open_Float x Global Pl.		0.00748	0.0225		-0.0585**	-0.0739***
		(0.0289)	(0.0368)		(0.0231)	(0.0260)
Constant	0.499***	0.500***	0.500***	0.505***	0.505***	0.502***
	(0.0172)	(0.0171)	(0.0172)	(0.0169)	(0.0169)	(0.0171)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	4358	4358	4358	4339	4339	4339
Countries	160	160	160	160	160	160
adj. R^2	0.163	0.162	0.163	0.168	0.171	0.171

With the Within estimator, Peg_Open means a shift from float to peg given that a country is open.
With the Within estimator, Open_Peg means a shift from closed to open given that a country is pegged.
*, **, and *** respectively denote significance at the 10, 5, and 1% levels.
Robust standard errors in parentheses.

Table 3.40: Endogeneity issues - Sensitivity analysis

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	Monetary Policy Independence Index					
	Global Investors			Global Banks		
F.Peg_Open	-0.0272	-0.0414*	-0.0330	-0.0117	-0.0443*	-0.0365
	(0.0260)	(0.0245)	(0.0275)	(0.0268)	(0.0244)	(0.0294)
F.Peg_Closed	-0.00482	-0.00599	-0.00431	-0.00750	-0.00682	-0.00504
	(0.00974)	(0.00948)	(0.00976)	(0.00978)	(0.00967)	(0.00992)
F.Open_Peg	-0.0850***	-0.0698***	-0.0768***	-0.0818***	-0.0405	-0.0468
	(0.0244)	(0.0253)	(0.0273)	(0.0243)	(0.0246)	(0.0287)
F.Open_Float	0.00964	0.0113	0.0126	0.00662	0.0194	0.0204
	(0.0143)	(0.0146)	(0.0147)	(0.0148)	(0.0154)	(0.0153)
F.Int. Res.	0.106*	0.108*	0.106*	0.0787	0.0727	0.0729
	(0.0576)	(0.0577)	(0.0577)	(0.0534)	(0.0525)	(0.0525)
F.Dom. Fin.	-0.0587***	-0.0576***	-0.0580***	-0.0510***	-0.0500***	-0.0498***
	(0.0160)	(0.0161)	(0.0162)	(0.0155)	(0.0154)	(0.0154)
F.DesynchCPI	-0.0112	-0.0111	-0.0112	-0.0155	-0.0168	-0.0165
	(0.0139)	(0.0139)	(0.0139)	(0.0130)	(0.0130)	(0.0130)
F.Global Player	-0.0175	-0.0212	-0.00444	-0.0250	-0.00448	0.00446
	(0.0193)	(0.0256)	(0.0305)	(0.0165)	(0.0155)	(0.0193)
F.Peg_Open x Global Pl.	-0.0970***		-0.0616	-0.120***		-0.0328
	(0.0302)		(0.0519)	(0.0232)		(0.0423)
F.Peg_Closed x Global Pl.	-0.0218		-0.0338	0.00923		-0.0197
	(0.0363)		(0.0396)	(0.0225)		(0.0238)
F.Open_Peg x Global Pl.		-0.0951***	-0.0515		-0.153***	-0.129***
		(0.0363)	(0.0482)		(0.0229)	(0.0421)
F.Open_Float x Global Pl.		-0.00238	-0.0179		-0.0530**	-0.0614**
		(0.0305)	(0.0338)		(0.0223)	(0.0246)
Constant	0.504***	0.504***	0.503***	0.511***	0.509***	0.508***
	(0.0169)	(0.0172)	(0.0173)	(0.0160)	(0.0162)	(0.0163)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	4331	4331	4331	4331	4331	4331
Countries	161	161	161	161	161	161
adj. R^2	0.157	0.157	0.157	0.163	0.167	0.167

With the Within estimator, Peg_Open means a shift from float to peg given that a country is open.
With the Within estimator, Open_Peg means a shift from closed to open given that a country is pegged.
*, **, and *** respectively denote significance at the 10, 5, and 1% levels.
Robust standard errors in parentheses.

General Conclusion

> People are concerned about whether openness is fair, whether it is safe, and whether it is equitable.
>
> *Mario Draghi*
>
> *Jackson Hole Conference, 25 August 2017*

The reduction of inequality appears as an important policy, especially in advanced economies but also in emerging world with a sufficient level of development. Indeed, these rising inequalities could trigger risky household leverage bubbles. Focusing on emerging world, the policymaker should also implement macroprudential (i.e. *ex-ante*) and *ex-post* policies. Specifically, they should conduct taxes on both short-term and long-term and subsidies on capital in boom and bust times. Because of an excessive reliance on long-term debt, the overborrowing mechanism could broadened over time. *Ex-post* policies are often disregarded and yet they are key: for a given level of debt, a particular debt maturity structure may extend the financial crisis. Finally, the third chapter on the Mundellian trilemma is a call for including exchange rate regime into the capital flow management policies. The choice of specific exchange rate regime still could help to isolate a domestic country against financial pressures. In addition, it calls for a macroprudential supervision centered on these *global players*.

There are a number of issues that are beyond the scope of this dissertation. First, the large literature investigates various transmission channels and highlights how these financial cycles generates crises and spillovers around the world. But it is hard to say how monetary and financial policies could shape the transmission channels. Second, national and global financial cycles are

closely intertwined, which in turn call for global coordination. Third, the design of capital flow management is a major challenge and raises several questions:

1. Should monetary and financial policies lean against the wind? At the same time, these policies have a stabilizing role and they generate destabilizing incentives, which in turn cause new crises. The debate between *ex-ante* and *ex-post* policies is still puzzling, because of the bunch of recent papers in this specific topic (Benigno et al., 2013; Jeanne and Korinek, 2016; Hernandez and Mendoza, 2017 and Bianchi and Mendoza, 2017). The same question holds for monetary policy: Gourio et al. (2017) highlight that this choice depends on various determinants, especially the sensitivity of crisis probability to excess credit and the level of global risk aversion.

2. The toolkit best practices should be discussed. For instance, is capital control a substitute or a complement for macroprudential regulation effectiveness? Korinek and Sandri (2016) is the first paper to present the potential complementarity of capital controls and macroprudential regulation as first best policies to fight against financial crises. The key is the presence of domestic and foreign lenders. Repayments to the former do not affect aggregate demand and domestic exchange rate, but repayment to the latter could generate sudden stops in vulnerable emerging countries. To quote Korinek and Sandri (2016), *"macroprudential measures creates a wedge between borrowers and savers whereas capital controls creates a wedge between domestic agents and foreign agents."* They call for this combination of both policy tools when collateral constraints depend on the exchange rate. In the case of asset price deflation in which the collateral constraint depends on asset price, they show that only macroprudential regulation is desirable with no role for capital controls. But this result has neither included strategic behaviors of savers nor considered the role of interest rate.

3. Policy responses to financial cycles also have distributional effects. The framework of Korinek and Kreamer (2014) investigates the trade-off between positive financial risk-taking and appropriate financial regulation. In the same spirit, Johnson et al. (2007) analyze how the use of capital controls helps politically connected firms (relative to unconnected firms). Finally, these works address the following question: are there political economy determinants of financial policies? The level and the structure of financial policies could depend on (i) the

presence of *global players* in the domestic economy; (ii) the domestic financial system size, concentration and efficiency ; (iii) the market power of domestic borrowing sector via banking dependence of small firms; (iv) the domestic savers interest in international financial system and (v) political determinants such as political parties, ideology and legislative structure.

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